HIGH-DUTY PUMPING ENGINES.

Experiments on a Direct-Acting Steam Pump.*

BY JOHN GEORGE MAIR, M. INST. C. E.

In the autumn of 1885 the author casually heard that a system of pumping, invented by Mr. C. C. Worthington, of the firm of Henry R. Worthington, of New York, was in use in the United States, enabling a Worthington direct-acting steam pump to work with as high a rate of expansion as any type of crank and flywheel engine, and at the same time exert a steady and uniform pressure on the pump plunger. He therefore determined to investigate and test its working. The motions of both a steam piston, and a water plunger being rectilinear, a connecting-rod, crank, and flywheel having a rotative motion, are superfluous except for the purposes of expansive working or controlling the length of stroke. Mr. E. D. Leavitt, Jun., who has a large and varied practice as a hydraulic engineer in America, explained to the author generally the peculiarity of the design of the engine, expressed himself in the highest terms of its mechanical efficiency, and kindly offered to assist in any experiments it was proposed to carry out.

The author took, as an assistant, Mr. Henry Smith, Assoc. M. Inst. C. E., and in order that no question should be raised as to the accuracy of the necessary testing instruments, a circular orifice, through which to measure the air pump discharge, three Kew-tested thermometers, an indicator, and also three tested Bourbon gauges for water and steam pressures were sent from England.

The inventor kindly placed an engine and its boiler entirely at the service of the author, and expressed a wish that the trials should be as complete and exhaustive as it was possible to make them. The engine was at work at Brooklyn, New York, and was put up solely for experimental purposes. It pumped out of a well, and through weighted relief valves back to the well, so that trials could be made which would have been impossible had the engine been performing the ordinary duty at a water-works. To pump about 1,700 gallons a minute through weighted and spring valves is a more difficult service than pumping against a head of water in a main. It was, therefore, evident that whatever results were obtained on the trials they could be readily repeated and improved upon in practice. Nearly twenty-five years have passed since the first Worthington compound-condensing engine was erected and set to work in America; since then great improvements have been made, and now these machines pump 40 per cent. of the total water supply of the United States. The system, however, is not much known in England, and so little attention has it attracted that there are no records of it in the Proceedings of this Institution, or in those of the Institution of Mechanical Engineers. In fact, it has not even been alluded to by the authors of the various papers on pumping engines that have been published from time to time. Practically the system consists of two independent engines and pumps lying side by side, the motion of one engine actuating the valves of the other. The delivery of water from the pumps is almost absolutely uniform, and although an air vessel is usually placed on the discharge chamber, it is generally waterlogged, and the author could not tell the difference in working either with or without air.

Fig. 1, represents, approximately, the flow from a Worthington pump at each point of the stroke. As soon as one pump begins to slow down at the end of the stroke the other pump starts, so that by combining the flow it will be seen how uniform it is. With any pump driven by a crank and connecting-rod, and even when two pumps are coupled on one crankshaft at right angles, great variation exists in the quantity of water delivered at different parts of the stroke, owing to the varying speed of the pistons, necessitating an air vessel being placed on the delivery main. The delivery from a compound rotative engine, with cranks at right angles, working two double-acting pumps, supposing the connecting rod to be indefinitely long, is shown by Fig. 2. The deliveries are added together and shown in full lines; the variation of flow in this case is sufficient to make the pressures fluctuate to such an extent that accidents are very liable to occur when working without air. The author, in his own practice, has met with many cases where accidents have happened to the pump work and rising mains, when through carelessness no air was in the vessel. But with the uniform delivery of the

Fig. 1.

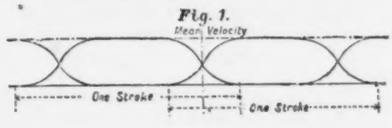
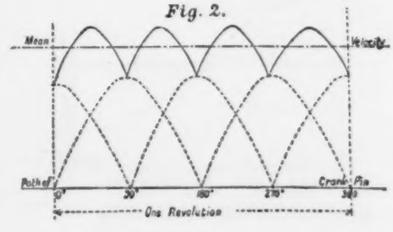


Fig. 2.



type of twin pumps before described an air vessel is not needed, and it is this uniform delivery that permits the use of the engine for pumping through the oil pipe lines where the friction in the main amounts to 3450 feet at normal speed. With the single and double acting pumps first used for this service, where the flow ceased at the end of the stroke, the pressure gauge fluctuated hundreds of pounds on the square inch with a corresponding result of broken pipes and pumps.

The oil pipe lines are of different diameter and lengths, and, taking as an example one that came under the personal notice of the author, namely, 6-inch in diameter and about thirty miles long, through which two 10 inch double plungers were forcing oil, the main would contain, if filled with oil at a specific gravity of 0.87, over 750 tons, and this weight may be considered as attached to the pump piston, a very simple calculation will show what excessive pressures are set up when such a weight is moved at a variable velocity, and also as a pressure in the pump is nearly all due to friction in the main, which increases or decreases practically as the square of the speed of the flow in it, it can be seen that the only system of pumping capable of working with safety is that in which the delivery from the pump is uniform and regular at every part of the stroke. There are now on the oil lines some sixty or seventy compound condensing engines of various powers up to 600 or 800 horse power. The service is a peculiar one, and the difficulties that have been overcome reflect the greatest credit on the engineers of the line.

The Worthington engine just referred to, although as economical in fuel as an ordinary Cornish engine, and more so if the first cost and the expense of foundations and houses is taken into account, can be beaten in economy of fuel by a well designed compound rotative engine working at a high rate of expansion. Mr. C. C. Worthington therefore applied himself to attach to his engine a form of compensation which would absorb or store up the excess of power at the steam end during the first part of the stroke, and give it out again during the last part of the stroke, when owing to expansion the steam pressure falls below the water pressure.

Now the main point to be observed in designing such an arrangement, is to obtain a perfectly uniform pressure on the pump plunger, so as to get a steady delivery of water. To effect this, compensators of many varied forms were schemed, and an experimental engine was made that would work up to about 150 horse-power, and a boiler arranged specially to supply it with steam. As it was almost impossible to obtain from the water-works sufficient water for the engine, a well was sunk, the entire plant with experiments having cost about £10,000. The engine was worked for about a year and a half continuously, and found to be such a perfect success that several are now at work, and many others are being made on the system that was in practice found best.

If the steam pressure diagrams of an expansive compound engine are combined together, it will be found that there is an excess of pressure $a\,b$ at the commencement of the stroke (Figs. 6, 7, and 8) over the mean pressure decreasing to half-stroke, and after that point there is an increasing deficiency of pressure $b\,c$. This variation with a rotative engine is taken up by the fly-wheel, but in the high-duty Worthington engine there are two small cylinders (by preference oscillating) which are attached to the piston-rod, containing water or air under pressure. Referring to Fig. 9 it will be readily seen that the excess of work $a\,b$, which is a maximum at the commencement of the stroke and decreases to nothing at half-stroke, is taken up by these small cylinders. Directly after half-stroke, when the steam pressure is below the water pressure, they give out work $h\,k$, which increases to the end of the stroke, so that if the work absorbed or given out in the compensators is combined with the steam diagrams, a perfectly steady pressure line is obtained, and the engine makes its stroke at a uniform speed, so that a straight pump diagram is obtained. The diagrams, Fig. 3, were taken from a high-duty pumping engine, working under ordinary service at New Bedford, Mass., U. S. A., the steam being expanded during the time it was taken some ten or twelve times.

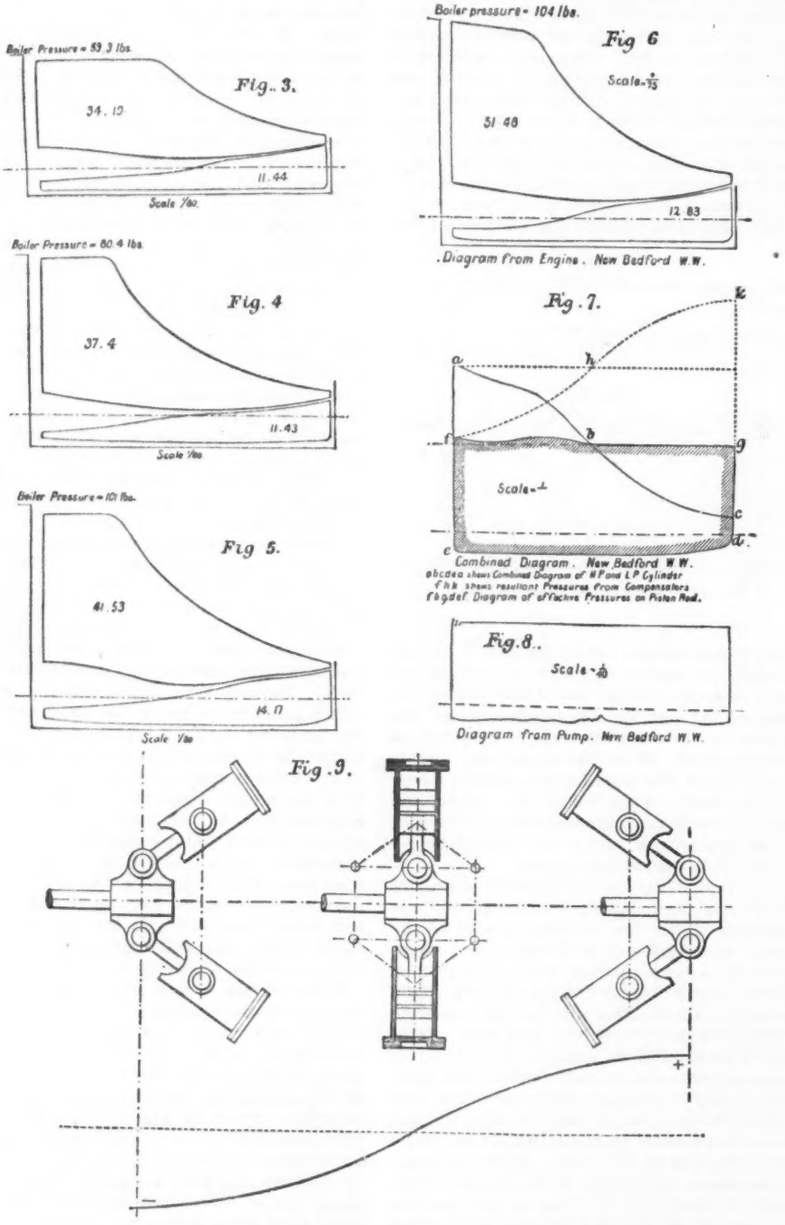
Engine Trials.—These trials were all carried out in a similar manner to those before made by the author.† Fig. 10 gives the general arrangement, plan of the boiler, engine, and pump, together with the position and details of the measuring tanks. The engine and pump are shown in Fig. 11. The feed water was measured in a cast-iron pipe, Fig. 12, with an overflow pipe in it, and its contents to the level of the pipe were weighed on tested scales many times over, the temperature being noted each time, so that the quantity of water in the pipe which was used as a feed measuring tank may be relied on as accurate. From the pipe the water was run into a wooden tank, out of which it was taken by the feed donkey and pumped into the boiler. Mr. C. C. Worthington placed one of his water meters between the feed pump and the boiler, and the meter readings agreed within ¼ per cent. with the measurements made by the author.

The boiler was of the Corliss type, vertical, 5 feet 4 inches in diameter by 14 feet high, with vertical tubes, and as the heat went direct from the fire through the tubes, and so

*From the Transactions of the Institution of Civil Engineers.

† Minutes of Proceedings of Inst. C. E., vols. lxx and lxxxi.

heated the steam above the water level, the steam was slightly superheated. A thermometer was fixed in the steam pipe in the engine house, the readings of which are given in the Tables. The steam pipe went across a yard in the open air but being well covered with non-conducting composition, and the steam being slightly superheated, condensation to any marked extent was prevented. The steam jackets drained into a tank, which was carefully measured, and when full the condensed water was discharged into a drain and the power. The steam from the main engine, after being condensed and passing through the air-pump, was delivered through a short length of pipe to the discharge tank (Fig 13.) where it was gauged through a circular orifice 3 inches in diameter. The temperatures of injection and air-pump discharge were read, and the head measured every quarter of an hour. Eight new indicators, made by the American Steam Gauge Company (and which were checked with the English one) were on the steam cylinder fixed close up to each head, author took personal observations all round every half-hour. so that no error could have crept in. Such detailed care was, however, not necessary, as the rejected heat was measured, and that gives the best check on the boiler supply. The stroke was kept the full length, touching the cylinder heads each time; and so regularly did the engine run that, for each trial, all observations were almost exact counterparts of each other. Independently of measuring the heat supply, many interesting experiments were made; the engine



High-duty Pumping Engines; Fig's 3 to 9.

Results of Experiments.

No. of trial	1	2	3
Double strokes per minute	45.0	39.26	40.10
Boiler pressure.....lb.	59.3	80.4	101.0
Feed water per minute (tank measurement) Fig. 12.	34.12	30.33	36.26
Jacket drains per min. "	4.22	4.15	4.57
Temperature of steam	359°	376°	390°
Pressure on pump, including suction.....lb.	78.5	80.5	97.0
Pressure in compensators..lb.	162.5	195.0	250.5
Mean pressure in high-pressure cylinder .....lb.	34.19	37.40	41.53
Mean pressure in low-pressure cylinder.....lb.	11.44	11.43	14.17
Temperature of injection	57·18°	57·10°	57·30°
Temperature of air-pump discharge..	84·95°	81·06°	89·50°
Head over centers of orifice .ft.	1·727	1·802	1·397
Air-pump discharge per minute.....lb.	1174·0	1197·0	1056·0
Injection water.....lb.	1144·0	1171·0	1024·0
Heat passing through engine per minute:			
T U from boiler, saturated steam through cylinders	35,132.0	30,919.0	37,553.0
T U from boiler, superheat in steam	853.0	772.0	906.0
T U from boiler, condensation in jackets	3,794.0	3,677.0	4,003.0
Total	39,779.0	35,368.0	42,462.0
Heat retained in condensed steam	1,585.0	1,283.0	1,822.0
Heat absorbed by injection water	31,769.0	28,057.0	32,972.0
Heat absorbed by indicated work	5,096.0	4,621.0	5,579.0
Heat absorbed by radiation	440.0	440.0	440.0
Error	889.0	967.0	1,649.0
Total	39,779 0	35,368.0	42,462.0
Percentage of error to total heat passing through engine per minute	2.2	2.7	3.8
Indicated horse-power	119.2	108.1	130.5
Pump horse-power	109.3	97.9	120.4
Efficiency per cent	91.7	90.6	92.3
Feed per indicated horse-power per hour through cylinders	15.05	14.53	14.57
Feed per indicated horse-power per hour through jackets	2.12	2.30	2.10
Piston speed per minute per engine.....ft.	97.5	85.0	86.9
Boiler pressure.....lbs.	59.3	80.4	101.0
No. of expansions	9.2	13.2	14.1
T U per indicated horse-power per minute	334.0	327.0	325.0
Doukin's coefficient	273.5	265.2	260.6
T U per indicated horse-power per minute, calculated from the temperature of the air-pump discharge	320.0	315.0	311.0
Pounds of coal per indicated horse-power per hour, supposing feed taken from hot well and the coal to give up 11,000 T U per pound‡	1.74	1.72	1.70
Duty in 1,000,000 foot pounds of water raised per 112 lbs. of coal, taking 88 per cent efficiency	112.1	113.4	114.8
Disposal of heat used:			
As indicated work...per cent.	13.3	13.5	13.7
Rejected heat and error—per cent	85.5	85.5	85.2
Radiation.....per cent.	1.2	1.3	1.1

time noted. The working steam, after leaving the engine, passed through the eduction pipe to an independent air-pump and condenser, worked by a separate engine. Both the feed-donkey and the air-pump engine were supplied with steam from a separate boiler, so that, in taking the efficiency of the engine into account, the work done by these pumps should be deducted. Their having a separate steam supply did not, of course, affect the heat used by the main engine itself, but only the efficiency, that is, the relation of the indicated horse-power to the pump horse-power and the diagrams were averaged by ordinates in New York, and checked by planimeters in England. Two counters were on the engine, which checked each other, and two tested water-pressure gauges were fixed on the delivery main.

Five assistants were in the engine room, and four in the boiler house. A ship's chronometer was used for the time, and every quarter af an hour throughout all tests gongs were sounded, one in the engine room and one in the boiler house, so that all observations were taken at the same instant, and the was slowed down until it made one double stroke in a minute and a half. The pump had its pressure suddenly released, to show the safety of the engine, and the air-vessel was filled with air, and was also water-logged; the compensators were put out of gear; in fact, every experiment was tried that was of value. The author made nine full trials, and Mr. Smith made three more, after the author had left New York. These trials were so regular that it is sufficient to give the details of three.

The absolute quantity of water delivered by the pumps could not be exactly ascertained;

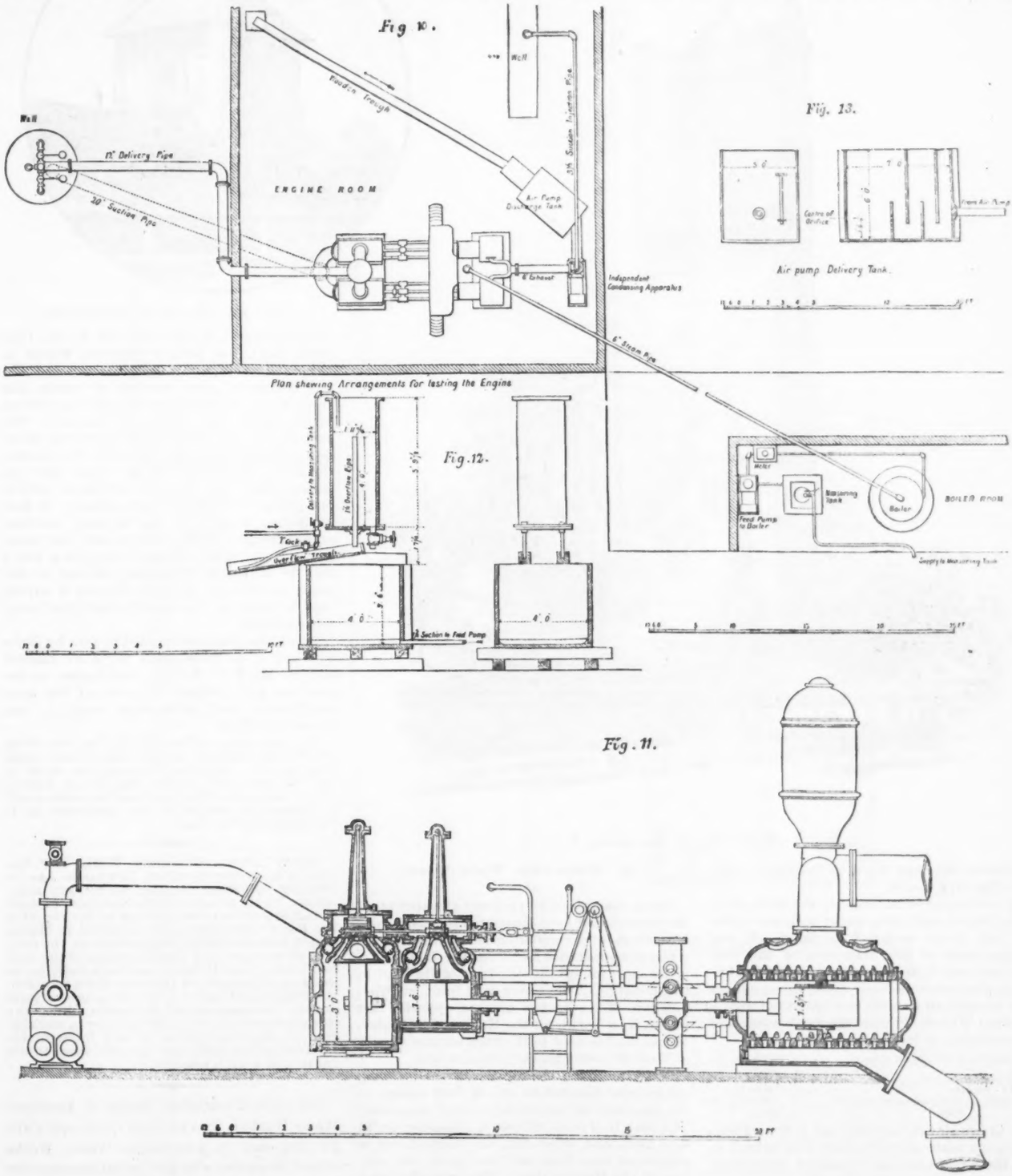
‡Minutes of Proceedings Inst. C. E., vol. lxx., p. 356.

but even if the full displacement of the plunger was not made, it would not affect the results of the trials, as the pump horse-power was taken from the actual pressure in the delivery main (as recorded by the gauges tested in England) against the area of the plunger, all connections and by-passes being carefully shut off and plugged before the trials. At the end of each stroke a pause was made to allow the pump valves to close before the return stroke, and so prevent slip through them.

The average efficiency on the three trials is 91.5 per cent., but from this has to be deducted the power it would require to work the air and feed pumps, and taking this at 3½ per cent., there remains a net result of 88 per cent. efficiency, or a higher value than is generally obtained by a crank and flywheel engine when the pump valves are tight. This is what would be expected, as the pistons of the compensating cylinders and trunnions certainly produce less friction than the crankshaft bearings, crank and cross-head pins, guide bars, eccentric straps, etc., of a flywheel engine.

The piston speed, as compared with the English practice, is very low, and naturally the repairs and renewals with these engines are of a most trivial character, even over long and extended periods of working. The foundations are simple, as the stresses are self-contained; in fact, the engine experimented with by the author was hardly on any foundation, and when doing 165 indicated horse-power, as it did on one of the trials, it was perfectly steady and worked without noise or vibration.

In another column is a summary of three trials: No. 1 on December 24th, No. 2 on



High-duty Pumping Engines: Fig's 10 to 13.

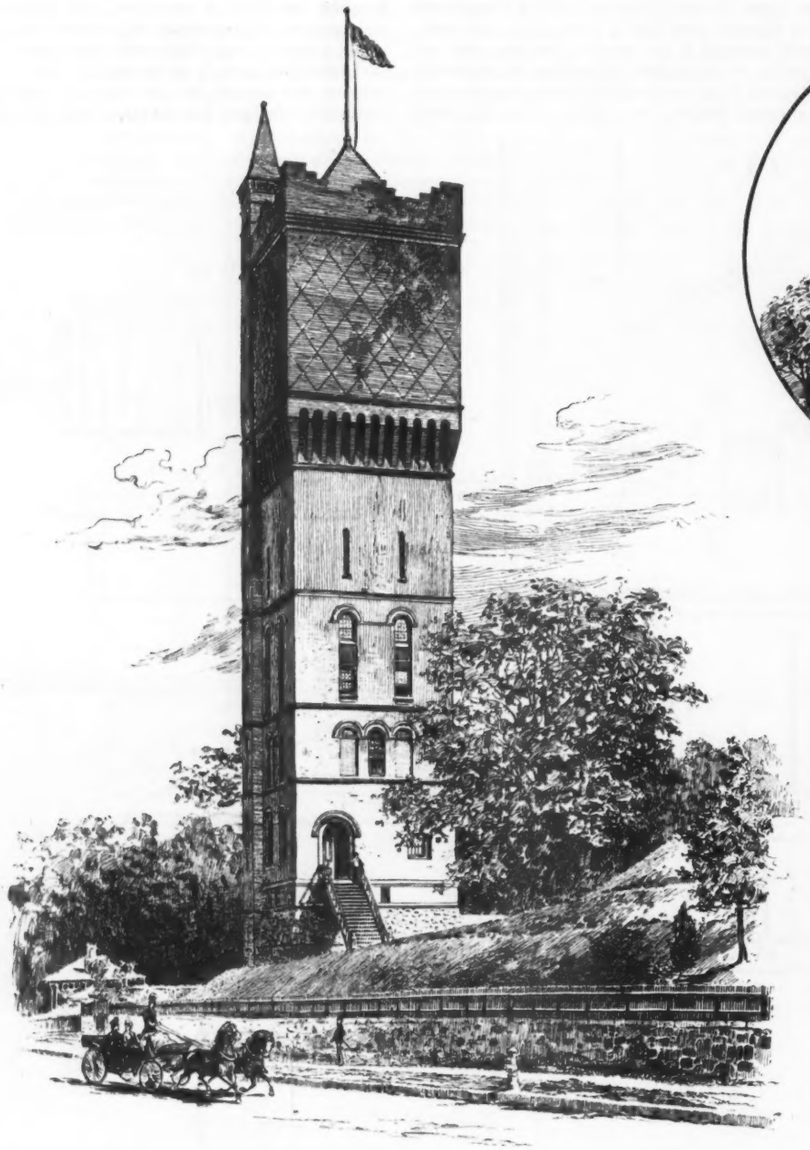


Plate I.—Water Tower at Weehawken, N. J.

Plate III.—Gate House; Weehawken.

December 19th, and No. 3 on December 22nd, 1885 (Figs. 3, 4, and 5).

In order to ascertain exactly the dimensions of the engine and pump under test, the cylinder and pump covers were taken off, and gauges made of the diameters of the four cylinders and their piston rods, and of the two pump plungers and their rods; these gauges were brought to London and measured with a standard Whitworth rule, the mean areas and lengths being as follow:

Low-pressure cylinders, area	1013.0 sq. in.
High " " "	251.0 "
Pump plungers, area	235.75 "
Stroke, length	26.00 in.
Clearance in low-pressure cylinder	596.0 cub. in.
" " high " "	336.0 "

As before stated, the coal was not weighed; and in the table above 11,000 T U is taken, so that these trials can be compared with those previously made by the author.*

The engine worked perfectly on all the trials; was easily handled, and fully justified the opinion of its merits expressed by Mr. E. D. Leavitt, Jr., and the inventor is to be congratulated on having achieved a result which could only have been arrived at by a thorough knowledge of mechanics, coupled with great perseverance and enterprise.

*Minutes of Proceedings Inst. C. E., vols. lxx. and xxix.

The Weehawken Water Tower.

As an example of an enclosed elevated tank, the water-tower here illustrated is conspicuous both from its commanding position and architectural appearance and from the fact that it is the most important structure of its kind in the country. This tower was built at Weehawken, N. J., (on the heights opposite 51st street, New York), for the Hackensack Water-Works, and is used in the high service supply of West Hoboken and adjoining towns.

Referring to the accompanying illustrations, the general dimensions are 34 feet square at the base and 140 feet high to top of the tower. The tank is of iron, 30 feet in diameter by 30 feet high, and when full, the water level is somewhat more than 300 feet above the surface of the Hudson river. The material used in the tower construction is brick with a stone basement. Plate II shows by a vertical section the manner in which the tank support is utilized in accommodating the boilers and engines and in providing an office for the directors and living and store rooms for the engineer.

The use of gothic arches in supporting a tank weighing, when full, 624 tons of 2,240 pounds, though considered bold at the time when built, has proved perfectly stable in three years' use, and has the advantage over any scheme of iron trussing or beams, that there is practically no springing of the bottom of the tank when filled or emptied. The arched ribs and spandrils are 1 foot in thickness, of brickwork, and the small floor arches the same. Three tie-rods were built into the walls to take the thrust of the large arches, but proved to be wholly unnecessary A flue, 24 inches square, at one corner, provides ample draught for the boilers, and the winding stairway, with cast-iron steps, in a well 4 feet in diameter, gives easy access to the upper stories and the roof, whence a superb view is obtained of town and country for many miles around.

This tower was constructed in 1883 by John F. Ward, C. E., from plans made by himself and by Mr. F. C. Withers, well known as the architect and designer of some of the most satisfactory and picturesque work in and about New York.

The gate-house (Plate III) is the one from which the engines in the water-tower draw their supply. It is also in design the work of Mr. Withers, and proves that in an artist's hand, such a building need not be made a dull and repulsive feature in the landscape, as is too generally the case.

SAFETY LAMPS.—Mr James Willis, Her Majesty's inspector of mines, Newcastle, has issued the following circular to colliery managers: "I am directed by the Secretary of State to call attention to the portion of the report of the Royal Commission on Accidents in Mines, which contains their observations on the relative advantages and disadvantages of the various kinds of safety lamps, and especially to the main condition which they lay down as essential to any safety lamd—viz., the source of light within the lamp should be unable, under any circumstences at all likely to occur in working coal, to cause the ignition of any inflammable mixture of fire-dsmp and air.even when this is passing at a high velocity,"

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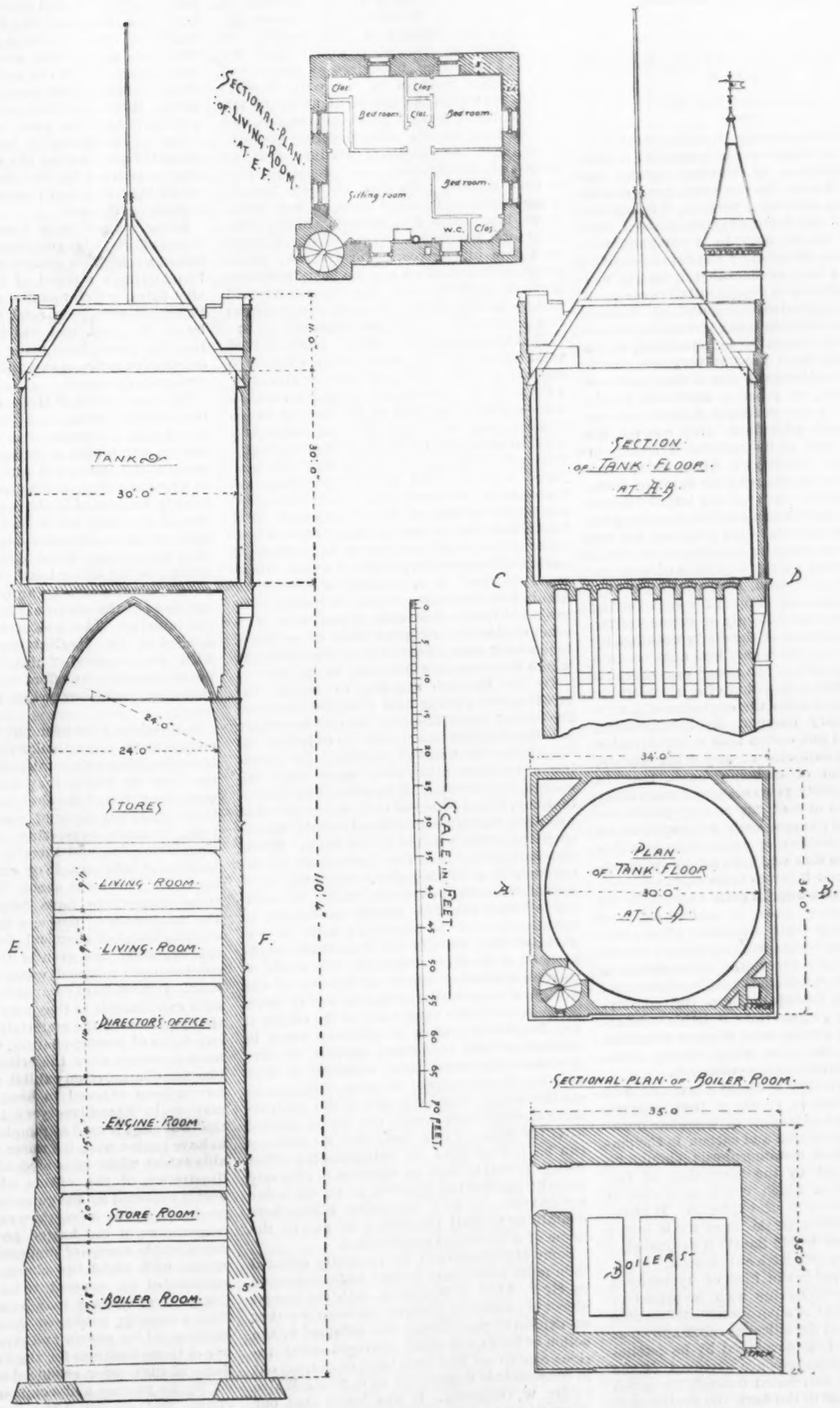

Plate II.—Details of Water Tower at Weehawken

ACCIDENTS IN MINES.*

VII.

Explosive Agents, and Particular Methods of Using Them.

(*Continued from page 279.*)

The supposed comparative safety of some descriptions of explosives, in composition more or less analogous to blasting powder, has been from time to time extolled, generally by more or less interested persons, it being contended that the firing of shots charged with them was not, or only in a comparatively slight degree, attended by the development of flame. To a very considerable extent, at any rate, a knowledge of the quantitative composition of an explosive compound or mixture admits of an estimate being formed the extent to which such contentions are justified, and it is certain that there are but very few practically useful explosive agents of that class now in the market, or possibly available, which, when used in the ordinary manner, possess any important advantage over powder, for blasting in coal or its associated strata, in respect to the liability of flame being projected into the workings by the firing of shots.

In the earlier days of the improvements made in gun cotton as a blasting agent, special forms of that material were prepared for use in coal, but the large proportion of carbonic oxide, developed by the explosion of even the most perfect gun cotton, renders its employment in the ordinary manner for coal getting out of the question, not only on account of the consequent vitiation of the air in workings by that highly poisonous gas, but also because the inflammability of the latter engendered a liability to the production of a considerable volume of flame upon the explosion of a shot in the ordinary manner. By incorporating finely-divided gun cotton with a considerable proportion of saltpetre or any other nitrate, the production of carbonic oxide may, in theory, be entirely prevented, and practically the proportion of that gas is very greatly reduced thereby; hence such preparations as *Tonite* and *Potentite* (the composition of which is based upon that of Abel's *nitrated* gun-cotton) have found favor to some extent as substitutes for gunpowder in drift work, or in the blasting of stone, over or underlying coal seams, although their shattering effects render them inapplicable with advantage in coal itself, where their superiority over powder in point of safety, if used in the ordinary manner, would still be doubtful. Even the employment of these preparations is liable to be attended by the development of more abundant flame than is the case when certain nitro-glycerine preparations are employed.

As nitro-glycerine contains a proportion of oxygen somewhat in excess of that required for the thorough oxidation or complete burning of all the hydrogen and carbon in the material, its perfect metamorphosis should be quite unattended by the formation of any trace of product which could give rise to flame at the moment of explosion. If nitro-glycerine is ignited in the open air it burns with a small and feeble flame; if detonated, a bright lightning-like flash only is seen.

When employed in the form of dynamite (a mixture of nitro-glycerine with one-third or more of its weight of a porous noncombustible material, such as the siliceous earth known as *Kieselguhr* the heat developed by its detonation raises to incandescence particles of the mineral matter distributed through the nitro-glycerine, so that in the dark the explosion is observed to be attended by the emission of sparks. Even if the nitro-glycerine were employed in the undiluted or liquid condition in a shot-hole, its detonation would have the effect of projecting incandescent particles of the tamping used, or of the coal or rock, which are within the sphere of action of the rush of highly heated gases and vapors, and the various known nitro-glycerine preparations, such as blasting gelatine, gelatine dynamite, lithofracteur, etc., would produce similar results, with this addition, that, in some instances, flame in more or less abundance might also be produced. In the case, therefore, of a blown-out shot, produced either with pure nitro-glycerine or with any of the preparations of which it is the basis, although no flame might be seen, the explosion would always be attended by the projection of sparks to a more or less considerable extent.

The temperature to which finely-divided solid matter may be raised when exposed to the action of the very great heat developed by a powerful explosive agent, when detonated or when strongly confined at the time of its explosion, may unquestionably be sufficiently high to determine the ignition of an explosive fire-damp mixture into which they are projected while in that heated condition, and there can be no doubt that it does not require the large volume of flame projected by a blown-out powder shot to bring about a fire-damp explosion in the event of an outburst of gas occurring in the vicinity of a spot where shots are fired. It is possible, moreover, for highly incandescent particles, or sparks, to be projected from a shot with dynamite, or with other explosives producing little or no flame, to places at some distance from the shot-hole, where fire-damp mixtures may be lurking.

To Dr. MacNab appears to belong the credit at first putting into practical execution the idea of supplementing the powder-charge in a shot-hole by water, with the object of extinguishing the flame of the shot. By inserting a cylinder filled with water over the charge, and confining it by a small amount of tamping, it was expected that when the shot was fired, the flame developed would be encountered and quenched by the water. It was also anticipated that the persistency of the smoke from a powder shot, consisting as it does of products of explosion which are soluble in water, would be greatly diminished by the dispersion of the liquid in a more or less finely divided state in the immediate neighborhood of the shot, so that the men would be thereby enabled to return to the site of the work in a comparatively short space of time. Some considerable experience of the effects of Dr. MacNab's system of applying water in connection with shot-firing appears to have demonstrated that decided economy of time may be effected thereby in stone drifting and similar works, in consequence of the comparative rapidity with which the air is cleared after the firing of shot, but, that no reliance can be placed upon an extinguishing effect being exerted to such an extent as to offer any security against the ignition of an explosive gas-mixture, or of a dust-laden atmosphere containing a small proportion of gas, by the flame of a blown-out powder-shot.

Some experiments to be presently referred to in more detail, were devised and commenced by Sir F. Abel at Woolwich, with the special object of obtaining positive evidence whether an explosive gas-mixture was inflamed by the action of blown-out shots produced under various conditions, and were later on carried out in considerable number for us in South Wales by Mr. W. Galloway. It was found that out of six powder-shots, consisting of charges of six and eight ounces, in 3-inch holes, having water cylinders 2 feet and 2 feet 2 inches long placed over them, and closely fitting the shot-holes, the blown-out shot fired the surrounding gas-mixture in four instances; in a fifth, there was some doubt whether ignition had taken place, and in the sixth, fired under the same conditions, the gas-mixture was not ignited. It can therefore only be said of this method of applying water in conjunction with a powder charge that it has the effect of considerably accelerating the removal of smoke after shot-firing, but that any protective power which the water may possess is altogether uncertain in efficiency.

Those commercially interested in Dr. Mc. Nab's efforts, have comparatively recently obtained a somewhat greater measure of success by adopting a method of applying water in shot-firing, which was first suggested by your Commissioners soon after our appointment, by Sir F. Abel, and which has, during the past five years, been made the subject of an exhaustive series of experiments by us, to be presently discussed.

The most recent of these experiments have included the firing of blown-out shots, produced with dynamite, with compressed gun-cotton, with tonite, or cotton-powder, and with gelatine-dynamite, and with the employment of water tamping, in the presence of coal-dust thickly suspended in air, containing a proportion of fire-damp below that which would furnish *per se* an explosive mixture. The shots thus fired always failed to ignite the mixture, which, on the other hand, was inflamed by powder-shots similarly applied or by blown-out shots of the above explosives, fired without tamping. The use of water-tamping as applied by Dr. MacNab, but in conjunction with the so-called "high" explosives, appears therefore to afford protection against coal-dust explosions when blown-out shots occur.

Suggestions have been put forward for the employment of particular solid preparations in conjunction with powder, with the idea that the heat to which they would be exposed upon the firing of the shot would cause them to evolve either vapor of water or other vapors, or gases, possessing the power of extinguishing fire, and thereby preventing the ignition of inflammable or explosive gas-mixtures by blown-out shots. The authors of these suggestions have failed to appreciate the importance of *time* as a factor, in the accomplishment of chemical decompositions of this character, and even in the liberation of mechanically retained water by the action of heat. It must have escaped their attention in such experiments as they may have witnessed, that portions of the materials composing the envelopes of powder-charges, when they have been recovered after the firing of a gun or a blasting charge, often exhibit no symptoms of having been exposed to heat, although they may be in themselves very inflammable, or that wet clay, if used as tamping, is not found to have parted with its water to an appreciable extent when recovered after firing. In illustration of the effects which are confidently expected by sanguine inventors to be produced, by the *momentary* exposure, to the temperature of the heated powder gases, of considereble masses of supposed extinguishing agents with which the charge is to be either surrounded or covered to a considerable height, the following may be usefully quoted, from a recently published description by its inventor, of the nature and supposed action of one of these nostrums for the extinction of the flame of gunpowder produced in shot-firing.

"By his process and compound, the writer claims that all difficulties are satisfactorily met and the desired absorption of the flame attained, not in killing the flame, but making use of it to effect certain chemical changes

*From "Final Report of Her Majesty's Commissioners appointed to inquire into Accidents in Mines, etc," 1886.

which no not decrease the force of theexplosion.....The compound consists of crystalised carbonate of sodium or soda crystals, carbonate of calcium, chalk, or marble, etc., the peroxide of manganese and soda soap. These materials are granulated, except the last-named, which is used as a lubricant (*what for, is not explained*).....The hole being ready for the charge, a quantity of the compound, sufficient to fill up the back of the (3″ or 3½″) hole, is thrown in and rammed; the cartridge.....is then put into the hole, and more of the compound is thrown in and rammed .....on the top of the explosive.....or, if preferred, a bag of the compound may be tied to a circular cartridge, the bag to be made of thin calico, saturated with a salt, such as silicate of soda, tongstate of sodium, or sulphate or phosphate of ammonium.....This done, the hole is stemmed or tamped up in the ordinary way, and the shot is then fired, the result being that *the high temperature immediately decomposes* the carbonates and transforms the water of crystalization in the soda into steam, and carbonic acid is produced. The calcium, chalk, or marble, is also acted upon by the heat, and, taking up the sulphurous acid of the powder, likewise yields carbonic acid, and any deficiency of oxygen to keep up combustion and effect these changes is provided for by the peroxide of manganese, which ensures the resulting (*?powder-*) gas being carbonic acid and not carbonic oxide; *immediately the explosion takes place* the coal is cracked in various directions, *and the pent up carbonic acid gas then rushes through these cracks.* and, as air cannot pass to the point of explosion, the flame is extinguished, etc.,etc."

These various changes and results, so ingeniously conceived, are developed with fair correctness and completeness upon paper; in actual practice, however, the great bulk of the " compound," if not the whole, would simply be scattered unchanged, the period of its exposure to heat being far too brief to bring about the predicted changes.

A plan, suggested by Sir F. Abel by which possibly the extinction of sparks projected from a shot of dynamite or other high explo sive shot might be insured, has been submitted to experiment for your Commissioner, by Mr. Gallaway. It consists in placing a cylinder containing compressed (liquefied) carbonic acid over the charge in the shot hole or in closing the explosive charge within the reservoir of compressed carbonic acid, or in placing the receptacles of liquefied gas beneath and above the charge of explosive In either case the detonation of the dynamite should shatter the gas reservoir, and the expansion of the carbonic acid, dispersed at that moment,should take place with sufficient rapidity to ensure the distinction of the incandescent particles projected into its midst.

In the first instance wrought-iron cylinders of the diameter of the shot hole, and 12 inches and 18 inches long respectively, filled with liquefied carbonic acid, were placed over the dynamite; in another experiment with dynamite charge was interposed between two short cylinders (6 inches), charged with the condensed gas. Sparks were observed upon firing the shots arranged in those two ways, and a subsequent examination of the recovered cylinders indicated that these had not been fractured in such a way as to favor the sudden dispersion of their contents. Trials were next made of wrought-iron tubes, composed of two chambers, a small one for the reception of the dynamite charge, and a larger one for the condensed gas, the smaller chamber being placed at the bottom of the hole. Several modifications of construction were introduced into this arrangement with the view of ensuring the immediate dispersion of the carbonic acid by the detonation of the charge. In the earlier experiments, the receptacles of the condensed gas were seldom broken up by the detonation of the charge to such an extent as to warrant the belief that the dispersion of the carbonic acid had been effected so immediately and thoroughly as to bring its extinguishing action into play properly, but eventually the cartridges used were so completely rent into fragments upon the detonation of the charge, that no doubt could be entertained on this point. Of these cartridges six were fired in strong holes in the Bute Merthyr Colliery; four gave no indications of either flame or sparks being projected (charges of 3 ounces of dynamite being fired in 3 feet holes, with about 15 inches of firm tamping over the gas cartridges); but in one case sparks were distinctly visible, and the last shot projected a number of sparks, although the gas reservoir was as completely torn to pieces as in the preceding experiments. It appears, therefore, that reliance could not be placed in the complete extinction of the projected fire, by the immediate thorough dispersion of the amount of condensed carbonic acid which could be brought into operation in a blast-hole, and the subject was consequently not further pursued.

More recent experiments have conclusively demonstrated that the projection of sparks by the firing of a shot is by no means an indication that there is danger of ignition of an explosive gas and air-mixture; so long as such highly heated particles are cooled down, at the instant of their issue from the shot hole, to such an extent as to be reduced below the temperature necessary for the ignition of such a mixture, they may obviously be projected into it with perfect safety while still in a luminous condition, and in a number of experiments a shower of sparks has been seen to pass harmlessly through a highly explosive gas and air mixture, because their temperature has been reduced to a perfectly safe degree (through the agency of water applied in a particular way). Hence the observation that sparks were occasionally visible in the experiments made underground with the condensed carbonic acid cartridges, by no means necessarily indicated a non-efficiency of the agent in those cases, as the hottest sparks may have been cooled down to a perfectly safe degree by the liberated gas by which they were enveloped. But as a very far simpler and very inexpensive plan of ensuring immunity against explosion resulting from the production of blown-out shots in the presence of an explosive gas or gas and dust-mixture suggested itself to Mr. Galloway while these experiments were in progress, no useful object was to be gained by further pursuing them.

In considering the possibility of applying the *detonation* of dynamite and similar nitroglycerine preparations to the safe blasting of coal, at the outset of your Commissioners' inquiries in 1879, it occurred to Sir F, Abel that the principle first developed by him, in 1873, of distributing the operation of the force developed by the detonation of small charges over a considerable area, by its instantaneous transmission in all directions through the agency of a column of water, *within* which the detonated charge was confined, might be applied to moderate the so-called local or shattering action, which rendered a violent explosive agent, of the kind referred to, inapplicable to the getting of coal, and might assimilate its disruptive effects upon the mineral to those of gunpowder; while, at the same time, the *enclosure* of the dynamite charge *in water*, in the shot-hole, might have the effect of quenching the sparks or incandescent particles which are projected when the employment of dynamite in this manner gives rise to a blown-out shot.

A few preliminary experiments made for the Commissioners at Garswood Hall Colliery by Mr. W. Smethurst, in November, 1880, demonstrated that very small charges of dynamite inclosed in cases which were filled with water could be detonated without inflaming an explosive gas-mixture by which they were surrounded, and these preliminary results were succeeded by others of a like nature, obtained at Woolwich Arsenal upon a larger scale in the following manner: Cylindrical holes, 3 inches in diameter and 4 feet deep, were bored vertically in very stiff clay; into these were inserted water-tight tubes of thin sheet tin, closed at the bottom and fitting the holes. The tubes contained charges of three or four ounces of dynamite provided with electric detonators and conducting wires, and made up in waterproof wrappers. After the insertion of the charges the tubes were completely filled with water, and their mouths were then closed with bungs, over which was placed plaster of Paris cement. The spaces over the tubes in the shot-holes were filled with clay tightly rammed. Before each shot was fired a cube-shaped bag, 4 feet high and 4 feet square, made of close canvas and painted so as to be fairly gas-tight, was drawn over a wooden framework, thus forming a very light gas holder. The open side of this cube was placed over the charged shot-hole; a delivery-pipe (leading from a coal gas-holder) was inserted into a small opening at the bottom of one of the sides, and reached to some distance up into the cube. Clay was banked up round the bottom edges of the latter, which rested upon the ground, to prevent gas or air from escaping except just in the immediate vicinity of the delivery-pipe. A sufficient quantity of coal-gas was then passed into the cube to form a moderately explosive mixture with the enclosed air, which it partly displaced. After a few minutes had been allowed to lapse, to admit of the gas diffusing itself through the air, the shot was fired. A preliminary experiment with a hole charged with powder and tamped in the ordinary manner showed that the gas-mixture inclosed in the cube was exploded by the firing of the shot, a large volume of flame being observed, while the cube was projected upwards and torn open. But the successive detonation of three dynamite shots inclosed in water in the manner described failed to fire the gas. These promising results were succeeded by several series of experiments which were carried on in the winter of 1880 by Sir F. Abel and Mr. Smethurst, at night, in Garswood Hall Colliery, the objects being to test the efficiency of this form of cartridge for coal-getting purposes, and to observe whether any sparks were projected, especially from heavily charged holes.

These experiments, some of which were witnessed by your Commissioners, showed that the action of the dynamite as a disruptive agent was entirely modified through the medium of the column of water within which the detonation occurred; the coal, instead of being shattered, with but little displacing effect, as is the case when dynamite is used in coal in the ordinary manner, was brought down in large masses, little or no small coal being produced, and the yield being fully equal to that furnished by the powder-charges ordinarily used, which were from three to four times the weight of the dynamite charges. In the majority of cases no signs of projected fire were observed when the shots were detonated, but on several occasions sparks were distinctly seen, though not in abundance.

(TO BE CONTINUED.)

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MAGAZINE RENEWALS.

The *Century Magazine* closes its yearly volume with the *October Number*. Renewals are in order for November. The price to ENGINEERING NEWS subscribers and their friends is $3.55; with ENGINEERING NEWS, $8.55. The new *Scribner's Magazine* will be out December 1, and we will make liberal terms to subscribers. *Harper's Monthly* is renewable on December 1 Orders ought to be sent in in November to save the publishers trouble.

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WE note with pleasure that our friend, Mr. John W. Weston, the editor of our cotemporary *The American Engineer*, has been appointed Commissioner General for the United States for the International Exposition of Railway Appliances and Industries, to be held in Paris in 1887.

This Exposition is to celebrate the Semi-Centennial of railways in France, and it is intended to then gather together representatives exhibits of the various industrial and professional branches connected with railways. These will include engineering appliances of all kinds, locomotives, machinery, passenger and freight carriages, hoisting and wrecking apparatus, heating and lighting apparatus, methods of inter-communication, couplings and brakes, buildings, furniture, electrical appliances, etc.

An International Railway Congress will at the same time be held for the important discussion of questions connected with management, exploitation, maintenance, rolling stock, traffic, etc.

This Exposition will present an excellent opportunity to American manufacturers and railway inventors generally to exhibit the the many superiorities of their products, and we sincerely trust that they will all assist Mr. Weston in his earnest endeavor to make a truly representative American exhibit. Any further particulars concerning space, regulations, etc., can be obtained by communicating directly with Mr. Weston, at 230-236 La Salle St., Chicago, Ill.

PATAGONIA is about the last spot on the earth's broad surface that we should expect to hear from as a promising site for railway enterprise. But the *South American Journal* now states that a Mr. A. Bell has applied to the Argentine Congress for permisson to construct the Central Patagonia Railway from Chubut to Chili; he only asks a land grant of "eight square leagues" for each mile of railway, and proposes to establish colonies along the line. He would start and end his railway at points too new to be found in our atlas of 1885.

MR. C. TANKERVILLE CHAMBERLAIN, in a letter to the London *Times*, estimates that the Panama canal will pay a dividend of 4 per cent. on £46,000,000. *Herepath's* journal in commenting on the letter says that the Panama, like the Suez canal, has met with much undiserved hostility.

ACCORDING to *Le Génie Civil* the construction of the 1,000-foot Eiffel tower at the Paris Exposition of 1889 has been definitely determined upon. The French government is to provide one million and the Eiffel Co. six millions of francs towards the cost of erection, and it is to be maintained during twenty years on the Champ de Mars.

REAR ADMIRAL LUCE in an interview published in a late number of the *Herald*, speaking of the demoralising quarrel between the line and staff in the navy, says, "It is idle to talk of ships or guns or men, until we can have system at the Navy Department and until we restore mutual confidence among the officers," and "I again repeat that all bills for the better government and improvement of the navy should be divested of features that will injure the co-ordinate branches of the Service."

All this is very well for the *line*, but in defiance of Civil Service rules, the head of the Bureau of Civil Engineers in the navy is a line officer, and line officers are generally, if not always, made chairmen of any commission to decide on engineering subjects, even though the chairman has to, as in one instance, ask what concrete is. We strongly advise the line to keep on agitating for such change in the rules or laws of the Department as will allow its engineering to be done without interference from men, who, however skilled they may be in their own profession, are without training, experience, or even theoretical knowledge of engineering. Even if some of them have to reside in New Jersey for awhile, as a penalty for their desire to "injure the co-ordinate branches of the Service."

The Drainage of the City of Mexico.

Having had the pleasure of a call from Senor Roberto Gayol, Engineer of the City of Mexico, we give the following as the present condition of the works now actually in progress for the long discussed drainage of the City of Mexico:

As is very generally known, the City of Mexico lies in the center of a valley or basin elevated about 7,500 feet above the sea. Immediately in front of the city is the large lake of Tezcuco which is now the general receptacle not only for the rainfall in this basin but also the drainage of the city itself. To prevent the re-occurrence of disastrous inundations from Lake Tezcuco and the smaller lakes surrounding it, a great ditch was dug through the hill of Nechistango, (completed in 1789); but, as this drain was too shallow originally and has since been partially filled up by the caving banks, other drainage works became imperatively necessary, especially for the disposal of sewage, and are now in progress.

A canal already exists leading from the city to Lake Tezcuco, but this must be deepened, and continued through the shallow bed of the lake to its northern extremity. This canal then passes to and through the smaller artificial lakes, made as storage basins to relieve the main lake in time of flood, until Zumpango is reached about thirty miles from the city. This canal will be low enough to drain the bottom of Lake Tezcuco, and in general will have a bottom width of eight metres (26.24 feet), side slopes of one to one, and a depth varying with its situation of from 23 to 77 feet, the last being the deepest cutting.

At Zumpango the confining range of hills is to be tunnelled; the total length of the tunnel being 9,250 metres, or nearly six miles. This tunnel will be egg-shaped, with inside dimensions of 13 and 12 feet; the base to the springing line will be built of stone masonry or concrete, and the arch will be brick, about 20 inches thick. The material penetrated is *toba*, a species of hard-pan which can be cut with a pick, but disintegrates upon exposure to the atmosphere. About 600 metres of this tunnel are already driven and twenty-four shafts are being sunk at distances of 400 metres apart, some of them being already at the tunnel level. The deepest shaft is about 333 feet.

After passing the tunnel the water finds its way into the upper branches of the Rio Panuco which finally empties into the Gulf of Mexico at Tampico. But as thousands of acres of land lie on the upper branches of this river, which could be made very productive by irrigation, the present intention is to devote the water of the Mexican valley to this purpose. Provisions will also be made for flushing this canal throughout its length by leading into it, through the City of Mexico, the pure spring water of the two higher lakes, just south-east of the city.

The estimated cost of this enterprise is about $4,000,000; and though the city is now at work upon it, it would consider any proper proposal for contract work. When completed this system would dispose of both surplus rain fall and the sewage proper of the city; and at the same time re-claim valuable land now partially flooded.

The Lighting of the Statue of Liberty.

The lighting of the Statue of Liberty in our harbor, while it is not yet quite a success, is somewhat more of a novelty than the collossal figure itself.

The electric plant for this purpose was supplied as a gift by the American Electric Manufacturing Co., of New York. The conditions

involved in lighting the statue, were of an unusual nature with two special features, viz: the illumination of the figure as a whole and the use of the torch as a beacon. In deference to the views of the Lighthouse Board, who feared that the original plan proposed by the American Co. would injuriously effect navigation, the plan actually adopted was as follows.

Five 6,000 c. p. lights are put in the angles of Fort Wood, in the center of which the statue stands, and ten 6,000 c. p. lights within the torch itself. This torch has thirty holes pierced in it in two rows and glazed; the ten lights inside are placed in acircle with a radius of 2 feet 9 inches. The six lights in the angles of the fort are provided with parabolic reflectors which cast the light upwards upon the figure.

The dynamo is a beautiful machine; it will support fifteen lamps of 6,000 c. p. at 875 revolutions with 30 ampéres and an E. M. F. of 700 volts. The total electrical horse-power in circuit is 32; the horse-power required at the dynamo-pulley is 35, and the electrical horse-power per lamp is 1.53, with an electrical efficiency in the machine of 91.5 per cent. The above description is condensed from the *Electrical World*, which contains illustrations of the torch, etc.

The Sewers of Paris.

The sewerage system of Paris according to the *Annuaire Statistique* of the City of Paris, divides the whole city into several distinct collecting basins; they are intended to gather the rainfall and domestic waste only, and to conduct these to such a point below the city that they can be discharged into the Seine at any condition of the river.

The Paris sewers are nearly all of recent construction; having increased in aggregate length from fifteen and one-half miles at the commencement of this century to a present length of nearly 316 miles. About 1800 there was only one sewer of any considerable dimension; that is, the old intercepting sewer built in 1750 in the bed of the ancient stream of Menilmontant, which followed north of the boulevards a depression still visible and emptied into the Seine near Chaillot. Into this collector, which was about 6 feet in diameter and considered then as of vast dimensions, the smaller drains were emptied which were successively constructed in the populous quarters of the "right bank" of the river, until it became too small to take more.

In 1830, when the sanitary improvement of Paris commenced to take some definite shape, new sewers were built emptying directly into the Seine in the front of Paris. The construction of a main sewer on the Rue Rivoli relieved the Seine to some degree of this foul flood, but only as far as the bridge de la Concorde. In 1856 M. Belgrand practically introduced the present systems of intercepting sewers to which Paris owes its actual condition of good health. This system is not yet actually completed, but it now drains an area of about 2,800 acres of the city in round numbers, which includes about all the city within the walls after deducting the surface of the Seine and its wide quays.

There are three principal collecting systems, 1: That of the right bank which leads to Asnières the drainage of 1,020 acres. 2: That of the left bank, which empties into the first at Clichy after having passed under the Seine at the bridge of Alma; it drains 1,080 acres. 3:—The north system which takes the water of the highest levels of the right bank over 480 acres. This last reaches the Seine at St. Denis, but the water is carried by a parallel canal to Gennevilliers.

In the system of secondary sewers, each street under 66 feet in width has one sewer, and each street 66 feet wide or more has two sewers. Paris has, in round numbers, 540 miles of streets in which the complete system would require 645 miles of sewers. Of this total system, 456 miles are finished, the remainder is yet to be built.

Besides the grand collector, forty different types of sewers are included in the entire system, the choice of section depending, of course upon the area drained and the gradient possible. These sections can be further divided into two greater types, viz.: those with side ledges or trackways destined to be cared for by mechanical means, and the type without sideways which must be cleaned by manual labor. The first class, especially when they receive large quantities of water, are considered as being capable of good service when the gradient is .40 m per kilometre (1.31 feet per 3280.9 feet) and on shorter and restricted lengths, it even passes slightly below this. In the second class of sewers any gradient under two to two and one-half metres per kilometre (6.56 to 8.2 feet per 3280.9 feet) is considered bad, and where circumstances sometime require this gradient to be made less the maintenance of the sewer becomes laborious and expensive.

The Paris sewers are cleaned as follows: In the sewers with side-ways and deep cuniform bottoms, three classes of machines are used. The first is a wagon or car somewhat like the ordinary contractor's cars, which is used in the care of sewers where water is not abundant, and in it the matter collected is conveyed to sewers better provided with water. A similar but smaller wagon is used in the secondary galleries, a special truck enabling them to be transported in the wider sewers. The second type of machine is a *wagon-vanne*, this is a wagon running on rails fixed on the side-ways or benches—as by the by, does the first wagon above described—and provided with a dropping apron which very nearly fits the outline of the wedge-like sewer proper which lies below the tracks. This apron can be raised or lowered by a gearing on the car; the water in the sewer being dammed up behind this obstructing apron passes the small space left about it with a force due to its head and cuts out and drives before the machine all obstructing matter, the wagon itself being propelled forward by the same hydraulic force as the sewer is cleaned. This machine advances in practice about 3280 feet in twenty-four hours, and will drive before it to the main collectors not only sand and mud but stones of considerable size. In the large collectors a similar system of cleaning is adopted; except that as the depth of the sewer below the tracks becomes greater, from 6 to 10 feet, the *wagon vanne* is replaced by a *bateau vanne*. This last is a boat provided like the wagon with an apron, and propelled in like manner by the force of the water in the sewer. Before the siphon under the Alma bridge is reached the collected matter passes into intercepting tanks whence it is removed by manual labor; floating matter is arrested by screens which are continually being cleaned. At Asnieres the collected matter is pushed directly into the Seine and causes considerable dredging.

It might be well here to add, that in the sewers above described, the upper portion has a nearly semi-circular section and is above the sewer proper, which latter is wedge form in section with the upper portion of less width than the first described part. Benches are thus left above and on each side of the real sewer, and on these benches are the rails used in connection with the wagons above mentioned. This type of sewer is very expensive in construction, as the area above the rails is just so much in excess of the actual carrying capacity of the sewer.

The Alma syphon is cleaned by flushing; provisions for this being made by a system of stop-planks in the entrance on the "right bank." As this system has not proved altogether satisfactory, M. Belgrand has supplemented the flushing process by the introduction into the syphon of a wooden ball about 31 inches in diameter, 6 inches less than the diameter of the syphon. If no obstruction exists the ball will pass on with the same velocity as the water; but if any collected matter obstructs it, the ball stops until the increased velocity of the fluid due to the decreased area, has cut away the mud or sand causing the trouble; the ball passes on in this way to the outlet of the syphon.

The British Ordnance Survey.

The last number of *Blackwood's Edinburgh Magazine* contains a popular history of this survey which the author traces to a military sketch map of a part of the Highlands of Scotland, commenced in 1747 by two quartermasters, Watson and Roy, who during the troubles of 1745 had experienced the necessity for more exact knowledge of roads and passes than was attainable.

Though, according to Roy, "on conclusion of the peace of 1763 it came for the first time under the consideration of government to make a general survey of the whole island at the public cost," nothing further was done till early in October, 1783, the eminent astronomer M. Cassini de Thury, set forth in a memoir the great advantages that would accrue to astronomy by carrying a series of triangles from London to Dover and there connecting them with the triangulation already executed in France, so that the relative positions of the Paris and Greenwich observatories could be ascertained. And in the summer of 1783 operations were commenced under the direction of General Roy, by measuring a base line, a fraction over five miles long, on Hounslow Heath. A military working party was furnished by the 12th Regiment of Foot, and the measurement, which extended over two and a half months, was made by a 100-foot coffered steel chain, cased glass tubing and thoroughly seasoned rods in 20-foot lengths, cut from a Riga mast and trussed. The measurements being repeated three times with each apparatus. On re-measuring this line in 1791 the greatest difference was under 6 inches.

In 1787 Roy had carried his triangles to the Kentish coast, Ramsden had built a 3-foot theodolite, and on the 23rd of September Roy met the French commissioners, of whom Legendre was one. The channel triangulation was finished October 17th, the French using a 12-inch repeating circle of Borda's make. This triangulation was repeated in 1861, thus connecting satisfactorily the English with the continental systems of triangulation, the English using the same old Ramsden's theodolite, which defines a man at a distance of thirty miles, aided by 24 and 18-inch instruments, the French adhering to their repeating circles.

Roy died about 1788 and nothing further was done till '91, when an opportunity presenting itself to the government to buy another Ramsden's theodolite and two new steel chains. "The Duke of Richmond, then Master General of the Ordnance, who seems to have taken an enlightened view of the situation, authorized their purchase, and such other steps as were necessary to proceed with the survey," which was continued with slight interruptions till the primary triangulation of the United Kingdom was completed in 1851. The accuracy of the work is shown by the

fact that two bases, the Irish and Salisbury, 350 miles apart, closed on each other within 5 inches.

Colby's compensation bars were first used in 1827 and 1828, measuring the Lough Foyle base 41,614 feet long, less 1½ inches. The Salisbury base, nearly seven miles long, originally measured in 1794 was re-measured with compensation bars.

The Ordnance Survey has published maps to three scales, viz: 1 inch per mile, 6 inches, and 25,344 inches. All the surveys are cadastral, the Irish survey, 6 inches, was undertaken in 1824 greatly for the purpose of a valuation of the town lands throughout the island. In this connection we quote from the article under consideration.

To the question—in our own experience not seldom put, and by persons who ought to be better informed—What are the objects the Survey subserves? it may be well to give here a categorical answer. These principally are: (1) military, and specially for laying out the national defences; (2) geodetic; (3) geological; (4) hydrographic, as supplying accurate coast details to the nautical surveyor; (5) archæological; (6) topographic; (7) for engineering purposes of all kinds connected with the construction and maintenance of water-works, gas-works, drainage-works, telegraphs, railways, roads, canals, harbors, etc.; (8) mineral surveys (9) parliamentary, in reference to standing orders; (10) sanitation, as under the various Acts relating to the public health; (11) delimitation of the civil and ecclesiastical divisions of the country, electoral divisions, municipal, county, hundred, parochial, etc.; (12) to facilitate the adjustment of jurisdictional areas, both governmental and for local assessments, as districts under the poor law, under school boards, under urban or rural sanitary authorities, quarter and petty sessional, assize, police, postal, and so on; (13) census and statistical information; (14) the enclosure and reclamation of waste lands; (15) registration of titles; (16) simplifying and cheapening conveyances of land, deeds of sale, leases, and all transfers of landed property; (17) for miscellaneous uses of general public or private interest. This, then, though far from being an exhaustive list, is a goodly enough one to furnish forth an ample *raison dêtre* for the prosecution and maintenance of a national cadastral survey.

As the supposed adhesion of England to the principle that Government should do nothing but to make and execute laws, leaving all the economic interests of the country to the care of individuals, is often quoted against expenditures for our State and National surveys by spigot reformers, attention is called to (7) (15) (16) and (17) above, all of which would be in this country relegated to private enterprise. The archological researches are carried on not only in the field, but a department is engaged in reproductions of facsimiles of ancient Mss. by photo-zincography; among other reproductions mentioned, are the Prayer-book of 1636, ancient Anglo-Saxon charters, Domesday book etc., which have been copied and published under the three and twenty years editorship of an accomplished gentleman expert.

Lancashire, and in general the richer portion of England, was surveyed before the adoption of the $\frac{1}{2500}$ scale, and it consequently is now demanding the latter or "property" scale survey with possibly a fair chance of getting it, as the surveys for the rest of the Kingdom are about completed, and excepting the country immediately about London, the richest and most fertile parts of Great Britain are mapped on a scale of 6 inches to the mile, from a survey now about 40 years old, while the more sparsely inhabited parts are depicted by the 25-inch maps.

The organization of the Ordnance Survey has always rested on a military basis though the personnel contains civilians. Up to 1855 the survey was conducted under the Honorable Board of Ordnance, and the directors were immediately responsible to that Board and its Master-General. The control then passed to the War Office and in 1870 it was transferred to H. M's Office of Works, and its appropriations have since formed part of the Civil Service estimates. The first Commissioner of Works and Buildings is now the head of the survey.

Besides its various duties enumerated above, the Ordnance Survey has served as a training school, to some extent, for the Indian survey and has made surveys at Jerusalem, Sinai, Cyprus, the Cape, Canada, British Columbia, etc., besides compiling many maps for the British Government,

On the Proper Horse Power Rating of Steam Engines.

The expert engaged in the testing of steam engines is not infrequently called upon to decide whether a steam engine is developing a rated horse-power, which, when sold, the engine-builder maintained it would develop. The decision as to whether the steam engine is developing the rated capacity, and if this is not the case, whether the engine-builder has complied with his word and the boilers are at fault, brings up some questions in the matter of rating of engines which it is of interest to consider and which it were well to see definitely and authoritatively answered.

When the engine is sold to develop a given horse power under prescribed conditions of running, steam pressure, cut off and revolutions, the boilers furnishing a stipulated quantity of dry steam for the development of the horse power, the matter is very simple. A test of the engine and boilers combined, made under the named conditions of running, will clearly show whether the engine is up to its guarantee, and if it is not, whether the boilers are or are not supplying the amount of dry steam demanded in the stipulation. If they are the engine is at fault, and it is the engine builder's duty either to correct the fault, or if he has over-estimated the capacity and economy of the engine furnished and the defect can not be remedied, to take out the engine and replace it by an engine fulfilling the conditions of his guarantee. Under these circumstances clearly he can be held liable for any damages or losses involved in non-fulfillment of guarantee or delay incurred by change of engine, or its insufficient capacity. The manufacturer can also, if he see fit, throw out the engine without paying the engine builder a cent, or may even hold him liable for the expense and damages incident thereto.

If, on the other hand, the boilers do not furnish the stipulated quantity of dry steam, the manufacturer can not complain of the engine, nor blame the engine builder, until he has furnished the prescribed quantity of steam and with such a supply the engine has also not come up to its guaranteed capacity and economy rating.

Thus far the matter is clear sailing. But now we reach the point where the trouble begins.

We do not believe that we over-estimate the actual condition of things, when we say that 50 per cent. of the steam engines purchased by manufacturers, are bought on the mere representation of the engine salesmen that the engine represents a certain amount of horse power. As to the conditions of running and amount of steam required, not a word is said. Still all along the manufacturer has in mind, and considers it granted, that the engine is to work economically, but either nothing is said to that effect, or the meaning of "economically" is left undefined.

A very natural tendency on the part of the builder is, whenever possible, to rate his engines high in regard to horse power, for thus he is enabled to sell his engines at a comparatively small first cost per horse power, and have a fair chance in competition with rival engine builders who resort to the same practice.

Now, the engine sold in this way, is put in place, and, let us say, does the required work, but the manufacturer notes a very large and unexpected fuel consumption. A test is made, and it reveals that the engine does develop the stipulated horse power, but in order to do so, is following one-half to six-tenths of the stroke, instead of cutting off at about one-quarter or one-fifth, which is, let us say, the economical rate of expansion for the special conditions. The effect is that the engine uses perhaps 50 per cent. more steam (and fuel) than if it were cutting off at one-quarter or one-fifth the stroke. Or, in other words, an engine of proper cylinder dimensions, cutting off at one-quarter or one-fifth the stroke, would develop the required horse power, consuming about 22 pounds of steam per horse power per hour, while the smaller engine in place must cut off at one-half, to develop the required horse power, and consume, let us say, 30 pounds of steam (or more) per horse power per hour.

Has the engine builder supplied an engine of rated horse power, or has he not? Has he the right to rate the horse power of his engine, on basis of steam following six-tenths of stroke? Nothing having been stipulated as to conditions of running, can he not run his engine as he chooses, as long as he develops the rated horse power? And can he not insist upon greater boiler capacity, if present capacity is not sufficient to supply amount of steam required by engine, even if the supply is ample for an engine which could develop the horse power under more favorable conditions of expansion?

These are some of the questions which arise. The engine will certainly develop the rated horse power, if it is given a sufficient steam supply, and so the engine builder appears on the safe side, even if conditions of running must be resorted to which are generally recognized, and are known by the engine builder to be decidedly uneconomical. Again if the engine does not require more than 30 pounds of steam per horse power per hour, the generation of which amount of steam per hour in boilers is, according to the generally accepted report of the Committee of the American Society of Mechanical Engineers, the standard unit of horse power of boilers, can not the engine builder justly claim that this rating of horse power of boilers implies that this is the amount of steam required on an average by modern stationary engines of average economy, and can he not urge it with much justice as a standard of rating of the horse power of his engine? As a fact, however, modern non-condensing engines, working under economical conditions, do not and should not use more than five-sixths to four-fifths of this amount of steam per horse power per hour, while condensing engines, running economically, require only two-thirds the amount.

It would seem that some expression as to what constitutes the proper commercial rating of horse power of engines should be given by some representative body, like a Committee of the American Society of Mechanical Engineers, as a guide in cases of dispute, and of value in causes at law. We know of several cases in litigation at the present time involving the issue under discussion, and of many more which do not reach the court room.

Of course all such disputes are avoided if manufacturers in purchasing steam engines consult, as they properly should do, unbiased professional steam engineers of standing, who advise them in the securing of bids and guarantees. Such engineers will not only see that all necessary conditions are stipulated, but

their very determination of the proper sizes of engines to be purchased will, in itself be a guarantee of correct rating of engines to secure desirable economy.

We think this problem of proper horse power rating of engines well worthy of discussion and of final authoritative solution. If the solution be that horse power developed, irrespective of amount of steam used and conditions of running implied, is to be accepted as commercially binding, well and good, but then it should so be definitely understood. Such a conclusion if sufficiently advertised would tend to make manufacturers and steam users more cautious in the purchase of steam engines, and place the purchase on a higher scientific level than it now occupies. We cannot see that a solution of the question is less important than the problem of steam boiler rating, which has so earnestly and effectively engaged the attention of the American Society of Mechanical Engineers.

The Result of Low Fares on the Elevated Roads.

On November 1st the fare on the New York elevated railway system was reduced to a uniform rate of five cents. The immediate result was that on November 2nd, the total number of passengers carried was 564,054.

This exceeds the previous maximum daily record, viz:—557,114 on June 5, 1886. The daily average during the last fiscal year was 315,369.

Statistical Tables of American Water-Works.

The rapid construction of Water-Works in North America during the past six years, very naturally suggested an attempt at tabulating the statistics of so important an interest. Very naturally also, this task devolved upon ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL, since from the very beginning of its existence, this journal has paid particular attention to the subject of water supply, and in the past eight years has actually published more on that one subject, than have all of its class contemporaries combined. In 1878 we published very full histories of several important water-works, but it was not till March, 1881, that we entered upon the systematic publication of the "History and Statistics of American Water-Works" under the sole editorship of Mr. J. J. R. Croes, who maintains the same relationship to that department of our journal at the present writing.

Mr. Croes was eminently fitted for the undertaking. He had already served a good apprenticeship in preparing similar statistics for the exhibit of the American Society of Civil Engineers at the Centennial Exhibition, and as a patient and persevering collector, and painstaking and accurate editor, of statistical information, few men are his superior. The carefully condensed histories of several hundred of the principal water-works of the country, published in this journal between March, 1881, and the beginning of the present volume, attest the persevering industry of the indefatigable editor.

The Statistical Tables are the natural outgrowth of these "Histories," and in their very condensed shape hold an amount of information on the subject of American water supply, that is being more fully appreciated with each biennial issue. The "Tables" have now an important place for themselves in the trade literature of the times. They are the familiar reference book in every Water-Works office on the continent; they are close at hand on the desk of every manufacturer of Water-Works Machinery and general supplies; Councils, on the eve of discussing a new water supply, order the book; insurance men have discovered its uses, and dealers in Water-Works securities cannot get along without it; newspaper editors gather from its columns of figures unanswerable arguments for any side of the question of water or no water; contractors, engineers and franchise hunters by its aid learn what fields are yet to win by knowing what is already won. It is emphatically a business manual of the first importance in its special department.

In 1883 we published the returns of 803 Water-Works, in 1885, of 969, and the present issue will give the statistics of about 1,400. These works are classified by States, an arrangement, the great convenience of which will appear at once to every interested party. The statistics are tabulated under the headings of the name of town; population in 1880, (a uniform basis for comparison being necessary); date of construction; ownership, (whether by the Public or by a Private Company); source of supply; mode of supply; date of returns; cost of works; the bonded debt, if any, the rate of interest paid; the officers; miles of pipe; number of taps; meters and hydrants; daily consumption; the ordinary and the fire pressure; annual expenses and revenue, and kinds of pipe used in mains and services. These are all arranged on the double page, and by means of wide spaces between lines and the use of leaders, are easily referred to, and there is space sufficient to allow of interlineations of new works by individual owners of the book as they are published or become known. There are many uses to which the book is put by different parties interested in Water-Works specialties.

In the forthcoming "Issue" an innovation on the past is introduced in the shape of a few pages devoted to such subjects as "Municipal Engineering and Details of Water Supply," which will describe the "General Plant of a Boston Distribution"; Laying Water Pipe"; Standard Water Pipe of Providence, R. I., showing sections; Weights and Dimensions of Water Pipe in Boston, Providence and Washington; How to find the Weights of Pipes and Castings; the Tools used in Pipe Laying; the Model Report adopted by the Water-Works Associations; an Index to Recent Literature of Water Supply; besides formulæ and notes, of every day usefulness.

The plan of publication has been to depend on the advertising patronage of the Water-Works interest of the country. To gain this, we contract to place a book in every water-works office in our list. This we have done most effectually thus far, as we have failed to learn of any such unsupplied, although we earnestly solicit such information. This plan is continued with this issue, and in addition thereto we propose to send out a press edition of 1,000 copies, which cannot fail to attract attention to the magnitude of the interests involved, and promote discussion of the general subject of public water supply. The value of such a medium for advertising has been appreciated already in the preceding issues of 1883 and 1885, and at this writing is even more satisfactorily attested by the increased patronage of the forthcoming issue. The size of the page is very large, and the prices are as follows:

Full page, $50; Half page, $30; Quarter page, $18; Eighth page, $10; Sixteenth page, $6; Thirty-second page, $4.

A book is mailed free to every advertiser; it is therefore possible to have a well-displayed card, giving name, address, and business, in the advertising pages and have a copy of the book, for $4.00. We trust we may be able to show a very fair directory of names in addition to the larger displayed advertisements of manufacturers and others. We think it will pay. The following is a list of advertisements received for publication to the 4th:

R. D. WOOD & CO., Philadelphia, Pa., Cast-Iron Water and Gas Pipes and Hydrants.
HENRY R. WORTHINGTON, New York City, High Duty Pumping Engines and Water Meters.
GLOUCESTER IRON WORKS, Philadelphia, Pa., Cast-Iron Water and Gas Pipe.
WARREN FOUNDRY & MACHINE CO., Phillipsburg, Pa., Cast-Iron Water and Gas Pipe.
SOUTHWARK FOUNDRY & MACHINE CO., Philadelphia, Pa., Pumping Engines.
DONALDSON IRON CO., Emaus, Lehigh Co., Pa., Cast-Iron Water and Gas Pipe, etc.
THE EDDY VALVE CO., Waterford, N. Y., Valves and Hydrants.
WATER & GAS WORKS CONSTRUCTION CO., Pittsburgh, Water-Works Contractors.
SAMUEL R. BULLOCK & CO., New York City, Water-Works Contractors.
G. J. ROBERTS & CO., Dayton O., Steam Pumps.
AMHERST HYDRAULIC MOTOR CO., Holyoke, Mass., Water Engines.
LAKE SHORE FOUNDRY, Cleveland, O., Cast-Iron, Gas and Water Pipe.
SILSBY MANUFACTURING CO., Seneca Falls, N. Y., Steam Fire Engines.
MELLERT FOUNDRY & MACHINE CO., Reading, Pa., Cast-Iron Water and Gas Pipe.
SAYRE PIPE FOUNDRY, Sayre, Pa., Cast-Iron Gas and Water Pipe.
HOLYOKE HYDRANT & IRON WORKS, Holyoke, Mass., Fire Hydrants.
HERSEY METOR COMPANY, South Boston, Mass., Water Meters.
WALTER S. PAYNE & CO., Fostoria, O., Water-Works Supplies.
A. H. HOWLAND, Boston, Mass., Water-Works Contractor.
FRED. ADEE & CO., New York City, Stop Cocks
LUDLOW VALVE MANUFACTURING CO., Troy, N. Y., Valves and Hydrants.
GOULDS & AUSTIN, Chicago, Ill., Plumbing and Water-Works Supplies.
SPRINGFIELD FOUNDRY CO., Springfield, Mass., Fire Hydrants.
THOS. KELLY & BROS., Chicago, Ill., Self-Acting Water Closets.
OHIO STREET LIGHTING CO., Canton, O., Street Lighting Contractors.
INMAN BROTHERS, New York City, Water and Gas Works Contractors.
WHITTIER MACHINE CO., South Boston, Mass., Water-Works Supplies.
ERSKINE W. FISHER, New York City, Portland Cement and German Asphalt Mastic.
HOWARD CHILDS & CO., Pittsburgh, Pa., Cast and Wrought-Iron Pipe and Water-Works Supplies.
E. R. DAVENPORT, Charleston, W. Va., Gas and Water-Works Contractor.
ALBERT L. WEBSTER, New York City, Sanitary Engineer.
AMERICAN WELL WORKS, Aurora, Ill., Artesian Well Contractors.
H. A. CARSON, Boston, Mass., Sewer Excavating Machines.
RANDALL FOOTE, New York City, Broker for Water-Works Securities.
OTTO GAS ENGINE WORKS, Philadelphia, Pa., Gas Engines.
BOURBON COPPER & BRASS WORKS, Cincinnati, O., Hydrants and Valves.
D. T. HUBBELL, Bethel, Conn. Eureka Tapping Machine.
CALVIN TOMKINS, New York City, General Construction Supplies.
TUERK HYDRAULIC POWER CO., New York City, Tuerk Water Motor.
STEBBINS MANUFACTURING CO., Springfield, Mass., Brass Goods, Stops and Cocks.
BASSETT BROS., Buffalo, N. Y., Water-Works Engineers and Contractors.
ALAN MACDOUGALL, Toronto, Canada, Sanitary Engineer.
E. DELEVAN SMALLEY, Canastota, N. Y., Water-Works and Sewers.
E. C. TERRY, Hartford, Conn., Bi Piston Water Meters
RANDOLPH BRANDT, New York, Selden's Patent Packings.
NATIONAL TUBE WORKS CO., McKeesport, Pa., High Pressure Water and Gas Pipe.

Sugar Mortar.

In connection with the notes on "Sugar as an Ingredient in Mortar," made last week, *Engineering* says that the practice of mixing "jaggery," or unrefined sugar with mortar in certain proportions is a very ancient practice in India. A wall so constructed in Madras was torn down in 1859, and it was found impossible to separate the bricks from the mortar. The mortar used was "jaggery" mixed with shell lime and river sand. The same correspondent to *Engineering*, Surgeon General W. R. Cornish, says that the famous polished *Chunam* walls of Madras are also prepared with cement mixed with unrefined sugar. Masonry cemented with this material requires blasting for its destruction.

Steel Pipes for Water Mains.

James Watson, M. Inst. C. E., and Engineer of the Dundee Water Commission has very recently made in effect the following report on four steel pipes, 12-inches diameter, submitted to him for a test as to their suitability for conveying water under high pressure:

These pipes were made of mild steel, the original plates having a tensile strength of thirty tons per square inch, and the plates forming the sockets and spigots a strength of twenty-six tons per square inch. The pipes were 10 feet 1¼ inch long and ¼ inch thick, made of two plates coated inside and out with black varnish; they weighed 18¼ pounds per lineal foot. The body plates and junctions with sockets and spigots were lap-jointed and riveted with mild steel rivets, the terminal pieces having been welded and turned on a shaping machine to the usual form.

When tested (in single length only) with water under 100 pounds pressure the pipe first leaked at the riveted joint; this pipe was then removed and caulked on the ground, and was then put under pressure to 700 pounds. The joint leakage was still observable, but was practically a weeping at three or four parts of the longitudinal seam. This pipe was subjected to a net compressive strain of 40¼ tons upon the end of the socket, or 8¼ tons per square inch of sectional area, without starting any of the rivets, with the final result of doubling back the steel socket but without any fracture in the socket.

The second pipe tested was hurriedly put together on the ground and did not stand quite as good a test as No. 1. The third pipe was 12-inches diameter, 8 feet 7 inches long and ¼ inch thick. It was made of one steel plate having a double riveted longitudinal lap-joint 1¾ inches wide riveted by ¼ inch revets with 1¼ inch pitch; it had angle-iron flanges at the ends, each flange being 2½x2½x¼ inches. This pipe was subjected to 760 pounds pressure, or the equivalent of 1,775 feet head. At this point a portion of the caulking yielded and a slight leak occurred at several rivets. As before, the weight of the pipe was eighteen and one-fourth pounds per foot; as compared with the weight of eighty-eight pounds per foot for a 12-inch cast-iron main tested to 600 feet.

Mr. Watson recommended this steel pipe for the crossing of the Tay Bridge, where there is considerable vibration and oscillation; and also for crossing some of the marshy districts in Strathmore. As to durability under use and the time, labor and tools necessary for repairing any accident on the ground, Mr. Watson says time alone can furnish the answer to these questions. In this connection Dr. Dupre, of London, has been lately experimenting on the action of soft water on cast-iron, wrought-iron and two samples of steel. After careful observation he concludes that if the loss on cast-iron be called one, the loss on steel was 1.020 in one sample and 1.098 on the other; or, that steel would lose in ten years as much as cast-iron in eleven years. Mr. Watson concludes by advising the laying of experimental lengths of the steel pipe as a test of its desirability for water-works purposes. No comparison of cost is given in the report.

Fast Railroad Time.

We must modify somewhat the statement made in our issue of October 23, as to the fast time made on the Delaware Division of the Philadelphia, Wilmington & Baltimore R. R. A letter from Mr. I. Mills, the Superintendent of the line, gives us the following data in correction of the press report copied by us:

Mr. Mills says the actual running time was ninety-seven miles in 103 minutes over his division, and from Delmar to Salisbury over the N. Y. P. & N. R. R., six miles in five minutes. Assistant Engineer L. W. Allibone, of the Delaware Division, tells us further that the curvature on this road is quite small considering its length; though there is one 6° curve 600 feet long and an 8° curve of 1,500 feet; there are three tangents from 8 to 14 miles in length. The grades are light, there being but one gradient of 0.925 feet per 100 feet, one or two of 0.4 per 100 and the remainder all less than the last.

According to *Poor's Manual*, this Delaware R. R., is 84 miles long and cost in total $1,811,716, or an average cost of $21,568 per mile. It is laid with 60-pound steel rail; and according to the same authority has paid regular annual dividends of 6 per cent., with five exceptions, from July 1, 1857, to July, 1886.

While the above record of time made is entitled to a place among the fastest long runs, it is more remarkable still when we consider the low cost of the road, about one-tenth of the cost of the average English railroad. We can only explain it, as usual, by the general efficiency of the American type of rolling stock, which permits the regular express trains on the same line to make an average speed of thirty-six and one-half miles per hour, including stoppage, according to the officers of the division. Another explanation in the matter of cost is, that this railroad was built thirty years ago, before the science of "stock-watering" was developed to its modern extent; a road constructed within the last few years through the same country cost about $60,000 per mile.

The "newspaper train" on the New York Central R. R., on August 8, 1886, made the run of 143.7 miles in two hours, twenty-four minutes, or at an average rate of 61.96 miles per minute. Although this is faster time than that made on the Delaware Division, is not as remarkable when the cost of the two roads per mile is compared.

Woodite.

Woodite is a new compound of caoutchout invented by Mr. A. M. Wood. It has all the elasticity of india rubber, but is uninflammable and uninjured by salt-water. It is suggested that it would be useful in covering the unarmored parts of war-ships and for torpedo-boats. This material closes over a shot-hole almost completely; and in an experiment by Mr. Nordenfeldt on a target made of thirty-six 8-inch cubes of woodite vulcanized on a ¾-inch iron plate, three six-pound solid shots, 2¼-inch diameter, were fired at right angles to the target, and two other shots at an angle of 45°. All of these shots passed through and punched out pieces of the iron back, but it required close scrutiny to find the marks on the woodite; the marks were only from ¼ to ½-inch in diameter. The oblique shots were quite as successful.

PERSONAL

PETER N. JONTE, Assistant Engineer of the Board of Public Affairs, Cincinnati, O., has resigned and F. S. WALLACE has been appointed in his place.

JOHN C. MILLER has been appointed civil engineer for the Land Title & Trust Co., of Philadelphia, Pa.

THOMAS STUART, engineer for the contractor who is building the new Minnesota & Northwestern R. R. Co's bridge over Rock river at Byron, Ill., was found dead at Rockford, Ill., October 23d, having been killed by a fall.

COL. CHARLES WHITTLESEY died at Cleveland, Ohio, on October 18th. He was born in Southington, Conn., October 8, 1808, and when yet a child was taken by his parents to Tallmadge, Ohio. He was a graduate of West Point, and in 1831-32 was a Lieutenant in the 5th Infantry. After resigning he was in 1836-37, practicing law in Cleveland, and for a time was one of the editors of the *Herald* of that city. He soon abandoned law, and engaged in geological surveying, principally for the United States Government. Among his more important work was the part he took in discovering and developing the iron a d copper region of Lake Superior; he discovered the now famous Gogebic range of iron ore twenty-six years ago. COL. WHITTLESEY was President of the Western Reserve Historical Society, and has published many scientific works, chiefly geological. During the *Civil War* COL. WHITTLESEY was temporarily engaged in the construction of the defences of Cincinnati, and other points along the Ohio river. He afterwards commanded the 20th Ohio Infantry, and served at Fort Donaldson and Shiloh, at the latter engagement as brigade commander. He resigned from the army in April, 1862, by reason of ill-health.

The American Society of Civil Engineers.

At the meeting of the Society on Wednesday evening last, Vice-President Rowland presiding, the paper of the session was read by Mr. Robert L. Harris, on "Notes of a recent visit to the St. Lawrence Bridge now being constructed at Lachine, Canada." After the reading of the paper Señor Roberto Gayol, Engineer of the City of Mexico, and Captain A. E. Piorkowski, of the German army, were introduced to the members. The first gentleman made some interesting remarks on the proposed drainage of the valley of Mexico, noted at further length in the present issue. Captain Piorkowski was equally interesting in his explanation of the principles, tests and efficiency of the Gruson type of chilled cast-iron armor for land batteries.

The following gentleman were declared elected to the several classes specified:—

FOR MEMBERS:—Alexander Gordon Brinckerhoff, (Stevens Ins. 1877) Engineer and Superintendent for Bates and Johnson Steam Heating Co. of New York, Brooklyn, N. Y.; Chambers McKibbin Craig (Sheffield Sci. School, 1875) formerly Assistant Engineer Mexican National Rd., Resident Engineer on Construction Mexican Central Rd., Topographical Engineer on Construction Panama Ship Canal; now Principal Assistant Engineer of the Macon and Dublin Rd., Jeffersonville, Ga.; Wilbur Fisk McClure, formerly Assistant Engineer in charge of Construction St. Louis and San Francisco Rd., Assistant Engineer Denning, Silver City and Pacific Rd.; now Engineer for the Mountain Water Co., Los Angeles, Cal.; William Lawrence Saunders, (Univ. Penna. 1876) formerly in Engineer Corps, National Storage Co. of New York; now Engineer for the Ingersoll Rock Drill Co., New York City.

FOR JUNIORS:—Christopher Newton Brown, Assistant Professor Civil Engineering, Ohio State University and Assistant on Ohio Geological Survey, Columbus, Ohio; Elijah Polhill Butts, Assistant Engineer Omaha Bridge, Omaha, Nebraska.

Engineers' Club of Philadelphia.

Record of Regular Meeting, October 16, 1886.

Past President Frederic Graff in the chair; twenty-three members and one visitor present.

Mr. J. E. Codman presented an illustrated description of a case of Low Water in a Steel Boiler, wherein the refilling of the boiler, after the exposed portions had reached a high temperature, produced no evidence of a tendency to crack in the steel.

Mr. C. O. Hering presented Tables of Equivalents of Units of Energy and Equivalents of Units of Weights and Measures, for the Reference Book.

Mr. J. H. Harden read a paper on Early Mining Operations in Berks and Chester Counties, Pennsylvania, giving the names of the charcoal furnaces, dates of construction, owners of the mines using the iron ore, location of the mines, management, cost and quantity of ore mined annually by the "Berks and Chester Mining Co.," beginning with 1836, under the management of Mr. William McIlvain, continued by Mr. Hartley Potts, Mr. Robert S. Potts, Peter Ubil, Fred. Richards, and John Kenny.

He refers to the operations of the "Pennsylvania Copper Company," Captain Thomas, manager, who died in 1808, and was succeeded by Mr. Richard Trewick, as manager and treasurer; its failure and sale by the sheriff in 1811.

Mr. Harden identifies Mr. Wm. McIlvan as the inventor and first user of the log washer for separating the fine ore from the dirt, and referred to its patent by Mr. John Milholland. He refers to the disputed boundary of the Jones Mine tracts, when the ownership was vested in Joanna Potts Martha Rutter and Sarah May as plaintiffs, and Daniel Buckley and Thomas and Matthew Brooke, defendants; also, the establishment of the "compromise line" by Messrs. Coleman, Barclay, Ralston, Bell and Gibbons, referees, Dec. 10th, 1801. He narrated the loss of all trace of the compromise line and the suit for trespass in 1857, in which Clement Brooke and Edward S. Buckley were plaintiffs, and David Potts, Jr., defendant. The decision being in favor of plaintiffs, was carried by Mr. Potts to the Supreme Court, where the decision of the lower court was reversed, and the final settlement of the disputed boundary was made by Messrs. Kendall Bros., Civil Engineers, November, 3, 1882. He refers to the present owners of the mines, model and map of the Jones mine, capacity for production, similarity to the Cornwall ore, cost compared with earlier times, etc, etc.

Mr. William E. Lockwood, introduced by the Secretary, gave a brief description and review of the progress made in the efforts to determine the "Hammer Blow" of a Locomotive's Drivers, since January, 1883, when Mr. Lockwood spoke on the subject of the Shaw locomotive before the Club, stereoptical views were shown of the Ashtabula Bridge before and after the accident, the conditions stated, and the suggestions made that the "hammer blow" might have been the cause.

Next were shown views of the Dudley Dynograph Car, including the machinery by which the conditions of the track are determinated, and a sample sheet showing the results.

The views following were taken from mechanical drawings of a dynamometer, by Mr. Thomas Shaw, M. E., which were submitted to a Sub-Committee of the Committee of the Sciences and Arts of the Franklin Institute, in October 1882.

Three views followed of a New Application of the Dynamometer for determining the "hammer blow" of a locomotive's drivers, as approved by a joint committee of the Franklin Institute's Committee of the Sciences and Arts; also by the Committee of the American Railway Master Mechanics Association. The report of each body was filed with the secretary; and the "Appendix" to the same, being a description of the dynamometer, was read and explained. The joint committee of the two bodies was composed of the following gentlemen: By the Franklin Institute—Prof. P. H. Dudley, of the Dudley Dynograph and Track Inspection Car, N. Y.; Theo. N. Ely, M. M., General Superintendent, M. P., P. R. R., Altoona, Pa.; Prof. S. W. Robinson, Professor Mechanical Engineering, Ohio State University, and Bridge Inspector of the Ohio Railway Commission, Columbus, Ohio; Edward Longstreth, M. E., of Messrs. Burnham, Parry, Williams & Co., (Baldwin Locomotive Works), Philadelphia: Thomas Shaw, M. E., Philadelphia.

By the American Railway Master Mechanics' Association—William Woodcock, M. M., First Vice-President of the Association, and Superintendent M. P. of the Central Railroad of New Jersey, Elizabeth, N. J.; T. L. Chapman, M. M., and Superintendent M. P. Chesapeake and Ohio Railway, Richmond, Va.; Charles Blackwell, M. M., and Superintendent M. P. Norfolk & Western Railway, Roanoke, Va.

Associate Members:—Coleman Sellers, M. E., of Messrs. William Sellers & Co., Philadelphia; Angus Sinclair, M. E., of the American Car Builder, Chicago, Ill.; and F. W. Deane, M. E., Dickson Manufacturing Co., Scranton, Pa.

Mr. Thomas Shaw was elected chairman of the joint committee, and Mr. F. W. Deane, secretary.

Following these were shown the coupling pins and pulling bar, which attaches the tender to the locomotive and these demonstrated in their "wear and tear" the difference between the present system of "rotating counterbalance" and "steam self-balancing counterbalance."

Three views were then shown of appliances recently constructed to prove, as Mr. Lockwood states it, that the top of the driving wheel, when in contact with the rail, moves twice as fast as the bottom, and that the bottom stands perfectly still.

Howard Murphy, *Secretary and Treasurer.*

CORRESPONDENCE.

Cost of "Barber" Pavements.

Editor Engineering News:

In your issues of October 2nd, I read of the Barber pavement on Chambers street, that the price to be paid by the city is $1.00 per square yard.

For some time you have quoted Barber's Asphalt Pavement $2.50@$3.00. In your number of October 16th, under the head of Asphalt Paving, it is noted that the Western Co. bids $2.61, and the Barber Co., $1.25 per square yard, in St. Josephs, Mo., and now the Topeka pavement report, noticed in your last number, shows that in Omaha the cost is $2.98. These two last pavements are guaranteed for five years, and the Chambers street pavement is guaranteed for ten years. The eminent engineer now at the head of the Department of Public Works, of your city, renderes it impossible that the extra dollar or more could have been required for "grease" and no other explanation seemes possible than that the additional five years guarantee increases the cost of the pavement under discussion at least 33 per cent.

If I am wrong in this supposition, will you please set me right.

Engineer.

Philadelphia, Nov. 2, 1886.

Stand Pipes.

Editor Engineering News:

In Mr. Hill's letter on Stand Pipes, p. 283, he says in relation to my formula for thickness of iron in stand pipes, that the U. S. Treasury regulations allow for double riveted work a maximum strain of 12,000 pounds per square inch of section of solid plate, "and not 23,000 pounds as stated by Mr. Ward."

As the greater part of his objections rest on this difference of over 80 per cent. I will show how this result of 23,000 pounds is reached, and that my statement is literally and exactly correct, and as a consequence Mr. Hill's is not. He refers to the law, so we will see what the law says in regard to that part of the country in which he lives and with which he might reasonably be supposed to be familiar.

"43rd Congress.

Be it enacted etc. That the provisions of an Act entitled "An Act to provide for the better security of life on vessels propelled in whole or in part by steam" etc., App. Feb. 28th, 1871, so far as they relate to the limitation of steam pressure of steam boats used exclusively for towing and carrying freight on the Mississippi river and its tributaries, are hereby so far modified as to substitute for such boats 150 pounds of steam pressure in place of 110 pounds as provided in said act for the standard pressure on standard boilers of 42 inches diameter and plates of one-quarter inch in thickness. And such boats may, on the written permit of the Steam Inspector of the District in which such boats shall carry on the business, be permitted to carry steam above the standard pressure of 110 pounds but not exceeding the steam pressure of 170 pounds to the square inch. Approved Jan. 6, 1874."

This working steam pressure on the 42-inch boiler of 150 pounds gives a strain of 12,600 pounds per square inch of iron. As Mr. Hill correctly states, an allowance of 20 per cent. is made in favor of double riveted joints which raises the permitted steam pressure to 180 pounds, and the strain to 15,120 pounds per square inch.

Now by Sec. 4418 R. S. (by which abbreviation the revised Statutes of the United States are referred to) all boilers are directed to be subjected "to the hydrostatic pressure," "and in all cases the test applied shall exceed the working power allowed in the ratio of 165 to 110 inches."

This makes the maximum pressure 270 pounds per square inch and plainly means a strain of 22,680 pounds in all sizes of boilers per square inch of section of solid plate, "and not 23,000 pounds as stated by Mr. Ward." To make the matter exact, Mr. Hill should do me the justice to allow that I wrote "nearly 23,000 pounds."

Our friend goes on to say "Under the United States Government rules a stand pipe 200 feet high and 20 feet diameter with drilled and double riveted vertical joints should have as the thickness of the plates in the lower ring with 60,000 T. S. steel or iron, 0.868 inch, instead of 0.459 or 0.551 inch (See R. S. 4433) as Mr. Ward puts it in his letter of the 15th ult."

Now when I said that the practice of the Government Inspectors in this country would give to a shell of that size to stand 200 feet head of water a thickness of 0.459 inch, instead of 0.6 inch as by my formula, my assertion was correct, as can be seen by any average arithmetician as follows: the Mississippi rule under the law of 1874 to find the thickness of any boiler for freight or towing purposes, made with longitudinal laps double riveted, can be formulated as follows—multiply the radius in inches by the hydrostatic testing pressure in feet, and divide by 52,350. In this case we get

$$\frac{120 \times 200}{52,350} = 0.458$$ which is my result to 0.001 inch.

The mistake Mr. Hill has made throughout is in calling the steam pressure allowed, the "maximum strain" when we all know that the water test is greater by one half than the steam pressure, as it certainly ought to be.

If Mr. Hill after all thinks that the inspection laws are wrong and that steamboat boilers should be made of a thickness 89 per cent. greater than the present law call for, he will probably have the good will of the boiler makers even if the owners should object.

I agree with my critic cordially as to the danger of collapse from wind in using too thin iron at the upper part of stand pipes, and in exposed situations as at Kankakee, extra stiffening in the shape of angle iron on the outside near the top would seem to be needed.

His idea of a variable constant, gives no constant at all, and as to a thickness of .774 for his pipe 30x208, if he tried to increase it to 1.46 he might in the face of Mr. Cook's experience meet with objection from the party who would have to pay the bills, and if he should think of reducing the lower sheet of his 5 feet pipe below .254 to be consistent and retain a constant E. S. for all sizes, probably he would not do it on second thought, and would not require any friend to call out to him "Don't"

Yours Respectfully,

John F. Ward.

New York, Nov. 2, 1886

The Value of Advertising.

Editor Engineering News:

In the crowd on "Bartholdi's" day, I heard one of two workmen ask the other "Whose statue is this, anyhow?" I lost the answer, but the query was significant, as suggestive of the animus which inspires many great works of these days; and recalling an idea which has found expression in many ways—and in your own columns—briefly expressed in the advice, Advertise! Advertise!! I found, if not an answer to the above query of *who*, certainly a clear explanation of the *how*, and *why*.

The French sculptor to whom we owe this undoubted work of genius and art, was yet but one of many, of equal prominence at least, in his own country. In a late speech he states that coming up our bay, some years since, he was struck with the possibilities of the situation, and as he says, "was fired with the ambition of one day realizing his great idea, etc."

We need not dwell upon his struggles and efforts to place himself at a single bound beyond the reach of competition in his art, as a realizer of great ideas—in short to *advertise* himself to a *new* world, as well as to the old. The labors of the artist, as such, great as they were, were but as child's play to the prolonged daily *grind*, continued through years, in order to obtain the means for his great undertaking, which was by no means seized upon with avidity by his countrymen in general. Does any one suppose that the inspiration to this, grew out of, or was sustained by any *sentiment*, such as this statue is supposed to embody? Not a bit of it! A business advertisement it was, pure and simple, from beginning to end, belittling by contrast, everything in this direction which has preceded it; clearly beating the Yankees in their own field.

The sculptor again visits our shores. A self-elected committee is on hand, and together matters are arranged, that the gift of *some* French people, shall pass as a spontaneous outburst of the French Republic. The recipients (the committee aforesaid) undertake to find a resting place for the statue, and the funds for its erection; and again the advertising element is invoked by passionate appeals to such as would see their names recorded among the patrons of Liberty, and much cheap eloquence is expended, playing on the sacred theme of gratitude due the French nation for their old time aid in our struggle for Liberty: and her later gift of the goddess herself, to rest for all time in our midst, exhibiting, as was intended, the kindred feeling of a Sister Republic, etc., etc., etc. But all in vain their appeal; it brought little response, awakened no enthusiasm, while the committee could advertise themselves to the

ages as devoted admirers and patrons of Liberty, or the French effigy of it—(as witness their names in imperishable bronze displayed on the finished pedestal); yet the people here enjoyed too much of the *real* thing, to respond to the feeble trumpeting in behalf of its image, or possibly, appreciated at its full value the disinterested efforts of its advocates in their appeals for dollars. The skill of the corner grocer was lacking in keeping himself well *behind* his wares, while he advertised their worth. And so there was fear that Liberty herself must go begging for standing room among us. In this emergency, an enterprising editor of a morning paper, taking in the situation, promptly availed himself of the opening, and taking up the matter entirely on his own hook, worked it for his own benefit, and throughout the length and breadth of the land, with a skill, patience, and perseverance, scarcely second to that exhibited by the sculptor himself, rivalled the latter in advertising himself, and his newspaper, as the organ of enterprise; at the same time posing as a patriot, philanthrophist, and promoter of civil liberty among men, and thus the needed funds were secured to set the goddess upon her feet; and there can be no question as to the fact, that but for the shrewd advertising dodge of booming this two cent newspaper, as a live advertising sheet, the statue might have rested, how long, no one can say—not as Dr. Talmage in his lecture has said "in boxes lying in some store house in Paris," but erect, as it may have been seen for a year or two, as a sculptor's card; and this use of the statue, should serve to rectify the inference, *allowed* to prevail, that the gift was not from private individuals, but from the French nation.

Is it to be supposed that in all this outcry for Liberty Lighting the World, any one concerned, from the enterprising editor to the ragged little gamin who subscribed his dime, and saw his name printed in the newspaper, cared a brass farthing for anything beyond the advertisement of themselves? Surely not; and thanks to this universal weakness, we have the ninth wonder of the world, in an undoubted work of genius, with us for all time, eclipsing in the way of colossiall which have preceded it in the past.

Working the advertising dodge, however, did not cease with the reception of the statue, nor with its erection complete. The volunteer delegation from France were heartily welcomed; arrived at the City Hall, and the speechifying began. Someone alluded to the occasion as "going into history," and accordingly our worthy Mayor incontinently "went in," and history was manufactured from that time until the completion of the ceremonies. The speakers, one and all, whatever might be the immediate occasion, never lost sight of the fact, that now was the opportunity, not to be neglected, to advertise themselves as candidates for the immortality which was to be had by all who blew their penny trumpet on this occasion in recognition of the greatness of the two Republics, and of the brazen statue which typically united in a common sentiment, both nations and under whose ample robes any defects in the speaker's pedigree, political or otherwise, would disappear then and there. We own to a feeling of regret at seeing the President of the United States lowering his high office to the extent of being a party to the consummation of this grandest of all advertising schemes—known as such from its very inception—could it be, that falling in with the humor of the day, he was advertising for a second term?

It would appear that all who had anything to do with this affair, were seized with the spirit of its designer—to advertise *themselves*. Loth to relinquish so fruitful a field, the newspaper referred to above, put the last touch to its sacrifice for Liberty, by printing in no less than eighteen solid triple columns of a morning paper (to which we look for the daily *news*) the names in full, field and staff; rank and file, numbering over 15,000 names, of all organizations, civil or military, found in the procession which waded through the mud to an honorable mention among the devotees of Liberty, and is it to be wondered at, that its presses, repeatedly started and worked to their full capacity, could not supply the demand for copies?

We need waste no criticism on this. It is called business, and where no claim is made for anything beyond turning an honest penny, it is well enough. But we have seen in this affair, a less open purpose, masked under the convenient cloak of disinterested patriotism, working for a high ideal. Men to whom this work of art, superb in spite of its dimensions, which tells of liberty sending out light, joy and blessing for all mankind, was but an advertising card; and precisely in the degree in which these sentiments are awakened should the feeling of contempt arise for the selfishness which can see in the embodiment of such an idea, only the opportunity for furthering a personal advantage, pecuniary or otherwise. Permit me a short anecdote in this connection.

Years ago, a church congregation in Boston subscribed for a bell to be cast abroad, and appointed four of their members as a committee to attend to the matter. The tone of the bell to be G sharp. When the bell arrived, it was found that the names of the four committee men had been cast on the bell. A wag asked, Why was the key note of this bell, like the proceedings of the committee who ordered it? Answer,—'Twas the sign of four flats! W.

LITERATURE.

Recent Publications for Land Surveyors.

The Surveyor's Guide and Pocket Table-book. By B. T. DORR, D. VAN NOSTRAND, 1886, 59 pages of text and 51 of tables.

A Manual of Land Surveying, comprising an elementary course of practice with instruments and a treatise upon the survey of public and private lands prepared for use of schools and surveyors. By C. T. R. BELLOWS, M. A. C. E., Professor of Mathematics in the Michigan State Normal School and T. HODGMAN, M. S., C. E., Practical Surveyor and Engineer, 1886. 360 pages of text and 100 of tables.

We congratulate the surveying fraternity upon the publication of these two books; first, because they are so far as we know, the only books intended specially for surveyors, which are in the pocket-book form; second, because they are the first book on surveying which give any adequate recognition of the fact that by far the greater portion of the area of this country was surveyed according to the U. S. public lands survey system. On our book shelves are four books on land surveying; the first devotes one page out of 393 pages of text to an explanation of the system used in subdividing the public lands; the second gives four pages out of 270 to the same subject, and the third allows 8 out of 303. In none of the above is the information more than should be known by every intelligent man resident in that part of the country where that system is employed; the information is not as complete nor as valuable to a would be surveyor, as the instruction given to the school children in many of the public schools of the West. The fourth of our books on land surveying devotes, in the form of an appendix, 16 pages out of 428 to an account of the principles of the system and of the process by which the corners were originally located, but not a word concerning the method to be employed in re-establishing a lost or obliterated corner. But few are engaged in original surveys, many are constantly employed making resurveys, and the latter must be acquainted, not only with all the formor is supposed to have done but a great deal in addition. The writers of the books on land surveying referred to above evidently believed that the system of public lands survey was so simple that an acquaintance with the elementary principles is all that is necessary to enable one to practice under that system. When the surveyor finds three original corners where he supposed there should be but one, or lines bowing which should be straight, or the original notes calling for the corner at one place and the witness trees calling for it at another, or that the witnesses were of a perishable nature and have entirely disappeared, or finds five methods, which give five different results for sub-dividing a section, or that the State Law conflicts with the United States Law, or that the United States Law and the instructions under them have varied from time to time, he will conclude that surveying under the public lands system affords an opportunity for the exercise of research, judgment, observation, skill, and above all good common sense. In most cases, and particularly under the public lands system, surveying is more a question of law and the rules of evidence than one of applied mathematics. The books under review are chiefly valuable in that they give information concerning what has been aptly called the judicial functions of the surveyor. The first is devoted almost exclusively to this class of questions, and the second gives 133 pages to matters relating to original surveys, sub-divisions of sections, re-surveys and location of lost corners.

The first begins by quoting the part of the United States Law relating to surveys of the public lands, explains the principles of the law as applied to the various cases which arise in practice, and gives clear and concise rules illustrated by diagrams for the guidance of the surveyor in the field. These rules seem to have been submitted to and received the approval of the United States Land Commissioner. There is a single page on the "Weight of Evidence," which might properly have been expanded considerably. Then follows 10 pages of practical "Hints to Beginners," most of which are very good. The author treats the important matter of local attraction in a very satisfactory manner; in this his book is in marked contrast with all books on land surveying. Mr. Dorr makes some very good suggestions about a form of the original record to be carried in the field by the surveyor, which is the first reference we ever saw in a book on surveying which even hinted that the surveyor should consult the original notes. The book contains a number of examples of cases actually occurring in practice and cites numerous decisions of the courts. All through the book there is evidence that the author is more familiar with field-work than with book-making. He should have classified his matter more closely, introduced subheadings to aid in finding the different subjects, and finally have added an index; the table of contents practically is of little help in looking up a topic. The book concludes, with two tables of a page each for finding the correction in direction of a random line, a traverse table, and a table of natural sines and cosines, and tangents and cotangents. A table of four place logarithms should have been added. The arrangement of the table of natural functions is intolerable. Both of the books before us have the defects of nearly all table of logarithms and trigonometrical functions; the different figures are not easily distinguishable, and the arrangement on the page is such that the computer needs a straight edge to follow the line to the desired number. The tables should be arranged so that the computer can pick out the desired number by simply glancing at the page.

The second book is evidently intended for a text-book, as well as for a book of reference for the surveyor in the field. The portion designed as a text book consists of a chapter each upon: 1, logarithms and trigonometrical formulas; 2, definitions and drawing instruments; 3, chain surveying; 4, compass surveying; 5, transit surveying; 6, solar compass and solar attachment; and 8, leveling and drainage surveying, and occupies 230 pages. Without entering into details we heartly commend this book as a text-book for students; typographically it is conveniently arranged, the statements are clear and concise, and the general treatment is such as will lead the student to do his own thinking. There are a number of valuable things in it not usually found in books on land surveying. We are sorry to find the authors advocating, at least by inference, the use of the solar compass, and saying nothing about local attraction. The method of finding areas both with the compass and with the transit is very good; the former is by double meridian distances, and also by total latitudes and adjacent departures; the latter is by the principles of the polygon.

Although the part intended for a text-book excells all its predecessors, the last part of this volume is by far the most valuable, and is unapproached by any other, unless perhaps we except the one associated with it in this notice. This part includes a chapter on original surveys, subdivisions of sections, re-surveys, re-location of lost corners, and one on miscellaneous matters including questions of practice, rights, duties and responsibilities of surveyors, and Judge Cooleys address on the "Judicial Functions of the Surveyors." The substance of 160 Supreme Court decisions is included, thus furnishing authoritative rules for nearly every case which has arisen, or is likely to arise in the surveyor's practice. No author could have afforded to collect all this material for what he could make out of it by publishing it in a book. This part of the work was done by the members of the Michigan Society of Engineers, and if we are not greatly mistaken, has received the sanction of the entire membership of that flourishing society, and hence the results here published may be regarded as exhibiting the best practice, and most approved opinions concerning the judicial functions of the land surveyors.

The book closes with tables of logarithms, trigonometrical functions, traverse tables, etc.

The Theory and Practice of Surveying. Designed for the use of Surveyors and Engineers generally, but especially for the use of Students in engineering. by J. B. JOHNSON, C. E. Professor of Civil Engineering, Washington University, St. Louis, Mo., etc. Size 6 by 9 inches 683 + XXIII pages including 54 pages of tables, 164 illustrations and 3 folding plates. J. Wiley & Sons, publishers, New York.

That our readers may form a just conception of the scope of this important book, we give a summary of the table of contents. Chapter I, instruments for measuring distances—the chain, steel tape, 12pp; II, instruments for determining directions—magnetic compass, solar compass, 42 pp; III, instruments for determining horizontal lines—wye level, hand level, 27pp; IV instruments for measuring angles,—the transit, the sextant, 30pp; V, the plane table, 9pp; VI, additional instruments used in surveying and plotting, aneroid barometer, pedometer, adometer, clinometer, optical square, planimeter, pantograph, protractors, scales, 42 pp; VII, land surveying, 50 pp; VIII, topographical surveying, 40 pp; IX, railroad (?) surveying, 10pp; X, hydrographical surveying, 64 pp; XI, mine surveying 21 pp; XII, city surveyor, 37 pp.; XIII, measurement of volumes, (earth-work) 27 pp; XIV, geodetic surveying, 139pp; XV, projection of maps 12pp; appendix A, judicial function of surveyors, 10pp; appendix B, instructions for the United States mineral surveyors, 14pp; and two appendixes of six pages of demonstrations of formulæ. Table of logarithms (4 places) traverse table to minutes, stadia reduction tables, natural sines and tangents to 5 places, earthwork tables.

This is the best book on general surveying which we have seen. In looking it over one naturally compares it with Gillespie's well known treatise which for more than thirty years has been the leading text-book in surveying; in most respects the new is superior to the old. This book gives a broader significance to the

term surveying than any former text book, and contains a good deal of material not heretofore found in this class of books. Doubtless it will have, as it should a large share in the education of coming generations of surveyors.

The principal thing wherein we think the book before us is superior to any other is that it discusses the capacity and limitations of most of the instruments used by the surveyor, and points out the most important sources of errors. At the close of the discussion of each instrument a series of problems, many of which are self-checking, are given to be worked practically by the student with the instrument, each of which is intended to bring into prominence a particular source of error. This is an application to surveying field practice of the principal of the Russian system of shop practice the introduction of which into our college machine shops has been so very fruitful; we believe this is a comparatively new thing in college classes in surveying, but we know of at least one institution in which it has been elaborately worked out with very beneficial results. This feature, particularly the self checking-element is very important, since it gives the student an opportunity to learn the amount of care necessary to secure a given degree of accuracy and enable him to learn the relative accuracy of different parts of the field work. It is nothing uncommon to find young graduates, and sometimes old practitioners, wasting time in carrying one part of the work to a far greater relative accuracy than another. By frequent suggestions the author puts the student on his guard against error in this direction. The sooner the student learn that surveying is an art and not an exact science, and learns to recognize inaccuracies and govern his actions accordingly, the better. However, the present book and the two on land surveying which we reviewed will do much to reduce the errors and limit the inaccuracies of surveying and make the art more nearly an exact science.

The author first discusses the various instruments used by the surveyor, and then takes up the theory and practice of the various branches of surveying. The method of treating the adjustments of the instruments is particularly happy; the geometrical relations involved are presented to the mind of the reader in such a way that a rule or method of adjustment naturally follows; the adjustments are studied as problems in descriptive geometry and not as mechanical manipulations to be memorized. As a rule the discussions of the various instruments, and the methods of using them are clear, concise and comprehensive. The treatment of the vernier is inadequate, and one of the two figures, like most vernier illustrations, is so poorly drawn as to be useless as an example of a vernier.

The trite subject of the declination of the magnetic needle is admirably set forth. A new chart showing lines of equal magnetic declination, is given and the reasons shown why no great reliance can be placed upon small maps. Like nearly all books on land surveying, this is very unsatisfactory on the important subject of local attraction; the author tells how to detect local attraction, and instead of giving a method of eliminating it, says that it "is practically impossible to use magnetic bearings" in localities where local attraction exist, in reference to which statement we beg to differ with the author.

The dumpy level deserved better treatment than to be omitted entirely, and more could profitably have been given concerning the self-reading leveling rod than to define it. In the discussion of barometric leveling, we would have preferred that the author should have shown the derivations of some of the more common barometric formulæ, and explained the reason for different barometric constants instead of deducing apparently a new one. He should have discussed the more important sources of error particularly gradient, and given data for the degree of accuracy attainable in barometric leveling. One of the unfortunate disproportions in the book is giving eighteen pages to the planimeter and twenty-two to the description, adjustments and use of leveling instruments.

The second part of the volume treats of methods of surveying, and begins by devoting seven pages to the system of laying out public lands, but nothing about resurveys, except to quote Judge Cooley's excellent address; *for students* the address is an imperfect substitute for detailed instructions concerning many of the questions which arise in practice, and consequently we are compelled to include this book in the list which we criticised adversely in our notice above of recent books on land surveying. This defect should be remedied, for the principles used in making resurveys in ordinary land surveying have frequent application in city and mine surveying, and should not be omitted in a book of this character.

The method of finding areas with chain is very deficient; only the method by the three sides is referred to, and nothing is said about passing obstacles, setting off perpendiculars and parallels, etc. The latter are of recent application in all surveying operations, and students should become very familiar with them; it is nothing uncommon to find old practitioners using a compass or transit to pass an obstacle, etc., when it could be more easily and as accurately done with a chain. The more of simple methods and the fewer of elaborate ones the better. The method of finding areas by measuring the lengths and bearings of the boundary line, both with the compass and the transit are very good; the discussion of the error of closure and the method of balancing the survey, contains new and valuable matter.

The two chapters on "topographical surveying by the transit and stadia," are practically the author's former book on that subject, which has not been edited for its present use; it is neither a full treatise on the stadia nor on topography, but it is a very good treatise on topographical surveying by the stadia. We consider it a mistake for the author in the stadia reduction table to tabulate the term cos. ^{2}, instead of the term sin. ^{2}; the latter could be multiplied by H and subtracted from H mentally much quicker than the former could be multiplied by H. [In our copy the binder has sandwiched the table of natural sines into the middle of the stadia reduction table.] The author should have explained the method of using a rod with an instrument for which the graduation does not suit. The second chapter is headed "railroad surveying," which is clearly a mistake, since only the topography of a railroad survey is considered.

The chapter on hydrographical surveying treats of soundings, measurements of velocity, formulæ for discharge, measurement of sediment in suspension, and is very satisfactory. The chapter contains several good points on plotting.

The chapter on mine surveying was written by C. A. Russel, of Colorado, a practicing mineral surveyor; "the object is to present the subject of mining surveying divested of all features, which, although they may give it a distinctive aspect, serve only to render it more complex and give the reader an idea of difficulties which are only imaginary." It gives examples of the method of procedure in some of the more general cases arising in the practice of mining surveying, together with many suggestions as to methods of overcoming difficulties likely to be met with during the progress of the work.

The chapter on city surveying, written by Wm. Bouton, City Surveyor of St. Louis, is most excellent; it contains valuable suggestions on laying out town sites, sub-dividing blocks, monuments, methods of measurements, office records, etc. The chapter closes with eight pages of valuable matter concerning the judicial functions of the city surveyor.

At first thought we were inclined to think that the chapter on the measurement of volumes (earthwork) was out of place in this book, but on reflection concluded that it was a good thing to include it here. Generally a discussion of the measurement of earthwork is to be found only in railroad engineering field-books, but others than railroad surveyors are frequently called upon to do this kind of work. The author states that it is not intended to be an exhaustive treatment of the subject of earthwork, but certain fundamental theorems and relations are established which will enable the student to treat rationally all ordinary problems. The article on approximate estimates by means of contours is good, and, so far as we know, new; it finds application in grading down or fielding up an extended surface. The prismoidal formula is deduced, and a table of quantities for applying it appended. Instead of entering into a comparison between Henck's method for three level sections and that by warped surfaces, it would have been better to have acquainted the student with some of the approximate methods in common use. The chapter closes with an article on the measurement of excavations under water, which is good.

It was doubtless an oversight that the author did not give a chapter on methods in leveling; as it is there is a little on that subject in the part on the description of instruments under the level and a little under the aneroid barometer, a little in the chapter on earthwork and the article on precise leveling in the chapter on geodesic surveying.

The chapter of 140 pages on geodesic survey is probably the best systematic treatise on that subject in the English languages. The only two books in English devoted to geodesy treat some phases of the subject more elaborately but are not as good a treatment for students as the one before us; they give too much attention to the elaboration of mathematical formulæ and too little to descriptions of methods, this gives a succinct account of the various operations in a geodetic survey although intended to "apply more particularly to secondary and tertiary triangulation." This chapter is carefully worked out, and has none of the defects of proportion that mar some of the others. Its most commendable feature is that it points out the points of superiority of methods which have stood the test of successful experience, and shows the cause of the failure of others. The description of the method of measuring base lines with a steel tape is new and valuable; the results obtained by this method are astonishingly accurate.

Instead of giving an elaborate table of heights of towers necessary to see a given distance, we would have given the close approximation the height of the tower in feet, is three-fifths of the distance in miles; the latter can be remembered and is always ready for use, while the former would never be at hand. We give this to illustrate a kind of work which should receive more attention in the recitation room. We believe it is a mistake to meddle with longitude and time, or much practical astronomy, in a book of this kind. The article on precise leveling is very good. We fail to comprehend the author's object in the chapter on map projection; it doesn't seem to lead any where, nor to be connected with the rest of the book. The logarithms and other tables at the end of the book are defective, as such tables usually are, in that the arrangement is that numbers can not be picked out by sight alone, without the use of a pointer or straight edge.

In our review of this book we do not wish to be considered hypercritical; we have aimed to commend the good points, and to point out what we considered the defects, with the hope that the latter may be removed in future editions, for the work will surely have many such, for there is unquestionably need of a book such as this is intended to be. The points with which we have found fault are probably due more to hasty preparation than to anything else. With all its defects we can commend it as a really valuable book, valuable both to the beginner and to the experienced surveyor.

NEWS OF THE WEEK.

Contracting.

Paving.—At New Orleans, La., the following bids have been received: Dennis Cronan, raising and repaving streets to grade, $1.85 per cubic yard; raising and resetting curb, 50 cents per superficial foot; new curbing, 85 cents per lineal foot. For brick sidewalks,—Coleman 84 cents per lineal foot;—Piplet, 75 cents.

Rip-Rap Granite.—For harbor of refuge, Nantucket, Mass.: John A. Bouker, New York City, $2.16⅝ per ton; James W. Luce, Niantic, Conn., $2.18; James Scully Groton, Conn., $2.24; Mt. Waldo Granite Works, Frankfort, Me., $2.47; Charles H. Edwards, Quincy, Mass., $3.31.

For harbor of refuge, Stonington, Conn.; John A. Bouker, $1.02⅝; Wm. H. Miothrop & Co., New London, Conn., $1.12; James Scully, $1.13; James V. Luce, $1.17; Mt. Waldo Granite Works, $2.47.

Steel Forgings.—The contract for furnishing steel forgings to the Ordnance Department has been awarded to the Midvale Steel Co., at 30 cents per pound.

Water-Works.—The following bids have been received by the city council of Carlyle, Ill., for a system of water-works: Water, Light & Power Co., St. Louis, Mo., $2,100 per annum; George S. Morgan, Chicago, Ill., $2,365; American Water-Works & Guarantee Co., St. Louis, Mo., $2,494. All bids were for 43 hydrants.

Dredging.—At Hyannis, Mass. Frank Pigdeon Dredging Co., New York City, 14.9 cents per cubic yard, measured in the scow; Alonzo J. and George B. Beardsley Bridgeport, Conn., 16 cents; National Dredging Co., Wilmington, Del., 20 cents; John McDermott, Cohoes, N. Y., 24.75 cents; Hartford Dredging Co., Hartford, Conn., 25 cents.

Pawtucket river, R. I. Elijah Brainard, New York City, 25 cents; Richard M. Payn, Albany, N. Y., 26 cents; Morris & Cummings Dredging Co., New York City, 29 cents; P. Sanford Ross, Jersey City, N. J., 30 cents; Thomas H. Benton, Elizabeth, N. J., 30 cents.

Providence river, R. I. William H. Beard, Brooklyn, N. Y., 8.5 cents; Atlantic Dredging Co., Brooklyn, N. Y., 8.8 cents; P. Sanford Ross, 10 cents; Morris & Cummings Dredging Co., 10.25 cents; National Dredging Co., 13 cents.

Providence harbor, R. I. Wm. H. Beard, 10.5 cents; Atlantic Dredging Co., 1.15 cents; P. Sanford Ross, 14 Co., cents; Elijah Brainard, 15 cents; National Dredging 16 cents; Morris & Cummings Dredging Co., 18 cents.

Pawcatuck river, R. I. Alonzo J. and George B. Beardsley, 12.5 cents; Richard M. Payn, 13.37; Frank Pidgeon Dredging Co., 16.95 cents; Hartford Dredging Co., 21.7 cents; John McDermott, 23.5 cents; Morris & Cummings Dredging Co., 32 cents; Elijah Brainard, 35 cents.

Choptank river, Md. Thomas P. Morgan, Washington, D. C. (awarded), 16 cents; George W. Parsons, Salisbury, Md., 19 cents; Frank C. Somers, Philadelphia, Pa., 20 cents; James Caler & Co., Norfolk, Va., 22.5 cents; Baltimore Dredging Co., Baltimore, Md., 23.75 cents; American Dredging Co., Philadelphia, Pa., 24 cents; Frank Pidgeon Dredging Co., 43 cents.

Scituate harbor, Mass. Blasting and dredging: Hiram W. Phillips, Quincy Point, Mass., $8.50 per cubic yard; John H. Smith, Scituate, $11; Green & Ornelias, Rockport, Mass., $12; Jesse & Lyman Boynton, Newport, R. I., and Boston, Mass., $15; George W. Townsend, $29. For dredging only, A. R. Wright, Boston, Mass., 41 cents per cubic yard; Bay State Dredging Co., Boston, Mass., 41 cents.

Contractors Intelligence,

Reported by T. H. Boorman.

Engineering and Building Materials,

WHOLESALE PRICES.

New York, November 4, 1886.

IRON.

STRUCTURAL IRON.		
Angles	2.10c	@ 2.25c
" steel	2.40	@ 2.50
Tees	2.50	@ 2.60
Beams and channels, American	3.00	@
Tank plates	2.25	@ 2.35
Shell plates	2.50	@ 2.60
Steel plates, Tank	2.70	@ 2.75
WROUGHT-IRON PIPE, PITTSBURG.		
Butt welded, black ... Discount		37½
" galvanized ... "		27½
Lap welded, black ... "		52½
" galvanized ... "		35
Boiler tubes ... "		45
RAILS.		
Steel (large lots at mill)	$34.00	@ $35.00
Old rails	22.00	@ 22.50
Old rails, steel	22.00	@ 23.00
R R. spikes	2.15c	@ 2.20c
R R. splice-plates	1.70	@ 1.90
R R. track bolts, square nuts	2.50	@ 2.75
Barb-wire fencing, galvanized	3.85	@ 3.90
" painted		4.00
Corrugated iron		
Nails		
Iron, per keg	1.95	@ 2.00
Steel do.	2.10	@ 2.20

METALS.

COPPER.		
Lake Superior	15.25	
Other Brands	10.37	
LEAD.		
Com. Domestic	4.00	@ 40.5
Lead Pipe	.06¾c.	
Tin-Lined Lead Pipe	.15	
Sheet Lead	.07¼	
ZINC.		
Sheet	5.62½	@ 5.70

BRICK.

Cargoes (afloat)		8.00
Choice Brands		
Haverstraw ... per M.	7.00	@ 7.75
Fishkill	6.75	@ 7.00
Up-River	6.75	@ 7.00
Jerseys	6.25	@ 6.75
Long Island		
Pale	4.75	@ 5.00
FRONTS.		
Croton, red	13.00	@ 15.00
" dark	13.00	@ 15.00
" brown	12.00	@ 14.00
Philadelphia pressed	24.00	@ 25.00
Trenton "	24.00	@ 25.00
Baltimore "	37.00	@ 41.00
Buff "	33.00	@ 35.00
Enameled English	85.00	@ 130.00
" American	80.00	@ 120.00
Fire brick ... American, No. 1	25.00	@ 55.00
" " No. 2	30.00	@ 35.00
	25.00	@ 30.00

ASPHALT.

ROCK.		
French, per ton	$22.00	@ 25.00
German	15.00	@ 20.00
According to quantity or brand, and whether taken from vessel or store.		
PAVEMENT.		
Barber's Asphalt	$2.50	@ $3.00

LIME.

Rockland Cement Co.'s Ground	.80	
Rockland, common per bbl	1.00	
" finishing	1.20	
State, common	.85	@ .90
" finishing	1.05	@ 1.10
Kingston, ground	.90	
Add 25c. to above figures for yard rates.		

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95	@ 1.00
" " No. 2 "	0.75	@ 0.85
" " light drab "	0.80	@ 0.95
Berlin " in rough "	0.75	@ 1.00
Berea " "		
Brown stone, Portland, Ct. "	1.00	@ 1.35
" Belleville, N. J. "	0.75	@ 1.35
Granite, rough	0.45	@ 1.25
Common building stone per load	2.00	@ 3.00
se stone, from 2¾ to 6 ft. lengths, per lin. ft.	0.40	@ 3.00
oncrete and macadam stone, Tomkins Cove, per cub. yd		$1.65

SLATE.

Purple roofing per square	5 00	@ 6.00
Green "	5.00	@ 6.00
Red "	10.00	
Black Penna. (at New York) "	3.50	@ 4.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@ 20.00
Choice "	65.00	@ 70.00
Tally plank, 1¼ in. 10 in. dres'd, each.	.44	@ .50
Tally boards, dressed com. "	.28	@ .30
SPRUCE, Boards dressed "	.25	@ .28
Plank, 1¼ in "	.28	@ .30
" 2 in. "	.38	@ .40
" 2 in. dressed "	.43	@ .45
Timber per M.	14.00	@ 18.00
HEMLOCK, Boards each.	.18	@ .20
Joist, 2¾ × 4 to 4 × 6 in "	.16	@ .44
OAK per M.	55.00	@ 65.00
CYPRESS 1, 1¼, 2 and 2¼ in "	35.00	@ 40.00
YELLOW PINE, Girders "	25.00	@ 30.00
Dressed flooring "	28.00	@ 35.00
SHINGLES, Extra shaved pine, 16in. "		
" sawed 18 in. "	5.75	@ 6.00
LATH, Cargo rate "	2.35	@ 2.40

PAINT.

Lead, white, American dry per lb	.04¾	@ .06½
" " in oil pure "	.07	@ .07½
" English, B. B. in oil	.08½	@ .08¾
" Red, American	.06½	@ .07
Litharge "	05½	@ .06
Venetian red, American "	.01	@ .01¼
Indian red "	.08	@ .10
Vermillion, American lead "	.10½	@ .11½
Paris green "	.15	@ .18
Umber, Amer. raw and powdered per lb.	.01¾	@ .02¾
Drop black, Amer. "	.07	@ .13
" Eng. "	.11	@ .13
Chrome green "	.10	@ .25
Oxide zinc, American "	.03½	@ .03¾
" French "	.05½	@ .07½

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

CALVIN TOMKINS:		
"Old Newark Co's." Cement		$1.10
BARTJER & MEYERSTEIN:		
Hanover Portland	$2.60	@ $2.65
BELLONI & CO.:		
Hemmoor "Crown" brand		2.50
JAMES BRAND:		
Burham	2.25	@ 2.50
Fewen	2.25	@ 2.50
BROOKS, SHOOBRIDGE & CO.	2.45	@ 2.60
FISHER, EBSKINE W.:		
Stettin (German) Portland Cement	2.40	@ 2.75
HOWARD FLEMING:		
Gibbs' English Portland, 400 lbs.	2.50	@ 2.75
K. B. & S. " "	2.25	@ 2.50
Stettiner, German	2.65	@ 2.85
Lagerdorfer, "	2.45	@ 2.75
Fieve, A 1, Belgian	2.35	@ 2.50
Roman	2.75	@ 3.00
Keene's Coarse	4.75	@ 5.50
" Fine	7.75	@ 8.50
" Superfine	8.50	@ 10.00
HUDSON RIVER CEMENT CO. Rosendale		0
JOHNSON & WILSON:		
Saylor's American Portland	2.15	@ 2.45
EMIL LENZ, New York.		
Stettin Portland	2.35	@ 2.55
Fire-proof	1.75	@ 1.95
LESLEY & TRINKLE, Philadelphia, Pa.:		
"Giant" Portland	2.20	@ 2.40
Improved "Union"	1.25	@ 1.50
Union	1.10	@ 1.20
NEW YORK CEMENT CO.:		
Rosendale		1.10
N. Y. & ROSENDALE CEMENT CO.:		
Rosendale, "Bridge" brand		1.10
SINCLAIR & BAUSON:		
Alsen's Portland Cement Works	2.35	@ 2.85
R. B. & S.	2.25	@ 2.50
STANDARD CEMENT CO		
E. THIELE:		
Dyckerhoff	2.90	@ 3.25
UNITED STATES CEMENT CO.:		
English Portland	2.25	@ 2.40
German "	2.00	@ 2.15
Standard	1.50	@ 1.65
Windsor and Improved Rosendale	1.00	@ 1.10
UNION AKRON CEMENT CO.:		
Akron "Star" brand	1.00	@ 1.10

MARKET SUMMARY.

The bad weather of last week has had some effect on the demand for materials in the wholesale market during the last few days and caused a drop in the price of Brick. Pale Brick only has held its own, and is quoted at $4 75@$5 00 per M.; the top price for Choice Haverstraw is $8.00; Firsts, $7.50@$7.75 per M.; Seconds, $7.00@$7 25; Fishkills command about the same price, and other Up-Rivers, $6.75@$7.00 per M.; Philadelphia, Baltimore and other Front Brick are unchanged in price. Rosendale Cement continues to meet with an excellent demand, and $1.10 is the lowest figure on first-class brands; Portland Cement continues to move in large quantities; the closing of the canal last Saturday will, however, stop the shipment of further heavy orders to the West, and importers will be moderating their shipments from abroad; the quotations for large quantities at ships tackles are $2.10@$2.20 per barrel for English and German brands; it is to be noticed that recently he German Cement has, as a rule, stood better to us than that of English manufacture and is more extensively imported. Lime is without change; a fair demand is reported at $1.00 per barrel for Rockland; $1.20 for Finishing, and State about 20c. per barrel cheaper. The Lumber Market is fairly active; no arrivals recently of St. John Lath, which are inquired for in quantities at $2.25 per M., with sellers generally asking $2.35 per M.; random cargoes of Spruce of small dimensions have rather dragged on the market, and sales are reported at $13.50 per M.; Special Schedules, $16.00@$18.00 per M.; Yellow Pine keeps steady at quotations of $18 00@$19.50 for random, and $19.50@21.00 for special cargoes. Turpentine has not held its own, and is dull at 37½c. per gallon. Hair is scarce, and will probably be higher; Coal has been sold at 35c. per bushel; Lead has recovered from the late depression, 4.10c. is a bottom price. In Pig Tin we find an improvement, as in the London Market, and sales of Straits are reported at 22 50c.@22.60c.; Tin Plate only in moderate request, with a tendency in buyers' favor. The Hardware Market seems as far as ever from a "boom," manufacturers complaining of not obtaining figures to correspond with the advance in materials; Nails hard to push, and sales reported at $1.95@$2.00 per keg for 10d @60d., with discounts even from the former figure.

BUILDING ITEMS.

Mr. Wm. Kuhles has completed plans for important improvements to Clausens' Brewery, which include a brick addition, 75x100, cost not yet estimated.

Mr. A. J. Manning has drawn plans for an extension, to be built to the stable of Mr. Cyrus W. Field at the rear of No. 123 East Twenty-first street, at a cost of $5,000.

Mr. John Brandt has designed for Mr. Joseph McGuire four five-story brick tenements with stores, to be built on the northeast corner of Tenth avenue and 153rd street, at a cost of $75,500; he is also preparing plans for four five-story brick, stone and terra-cotta flats, to be built on the northeast corner of Lexington avenue and 105th street for Mr. John C. Graham, to cost $65,000, and for Mr. Anton Halm he is designing a five-story brick stable, 36.8x98 to be built as a cost of $25,000, on the north side of Fifty-first street, between Second and Third avenues.

Mr. Frederick Jenth has completed plans for a four-story stone front residence, 20x50, to be built for the Church of St. Boniface at No. 307 East Forty-seventh street, at a cost of $10,000.

Messrs. Berger & Bayliss have drawn plans for two five-story brick tenements with stores, to be built on the southeast corner of First avenue and Ninety-first street for Mr. Matthias H Schneider, at a cost of $38,000.

Mr. Lawrence J. O'Conner is the architect for alterations to be made to No. 110 Attorney street for Mr. P. F. Collier, at a cost of $4,000.

Mr. G. A. Schellenger has plans for a $10,000 improvement, to be made to the property of Messrs. John Glass & Son on the south side Little Twelfth street and on the north side of Bloomfield street, 100 feet east of Thirteenth street.

Messrs. Palliser, Palliser & Co., of Vanderbilt avenue, have on hand plans for additions to be made to the Glen Tower Military Institute, Dobbs Ferry, for the Rev. Dr. Morton, which will cost $25,000.

Mr. George B. Pelham has on the boards plans for two four-story and basement brownstone residences and four five-story brick and stone flats, to be built for Mr. M. St inhardt, on the northeast corner of Ninety-third street and Tenth avenue, at a cost of $150,000.

Mr. Wm. Baker has on the boards plans for a large hotel, contemplated near Madison Square.

Messrs. A. B. Odgen & Son have designed for Messrs. Hollister & Friedline five five-story brick, stone and terra-cotta flats to be built at a cost of $75,000, on the northeast corner of Madison avenue and 112th street.

Mr. George Keister, No. 418 West Fifty-seventh street, has prepared plans for three five-story brick stores and tenements, to be erected by Mr. Wm. Rankin, on the east side of Ninth street between Thirty ninth and Fortieth streets.

Messrs. Herter Bros., 191 Broadway, have on the boards plans for a six-story brick, stone and terra-cotta flat, 25.3x102, to be built at No. 375 Broome street, at a cost of $25,000 for Mr. Wolf Baum.

Mr. J. F. Barrows has on the boards plans for two four-story brick and marble flats, 36x65, to be built on the south side of 139th street for Mrs. E. Roberts, at a cost of about $25,000.

Mr. John Corwin, of Flushing, L. I., will build two large residences on Amity street, Brooklyn, near the Methodist Episcopal Church.

TRADE NOTES.

THE MORRIS COUNTY, (N. J.) MACHINE & IRON CO. send us a handsomely illustrated catalogue of the mining machinery manufactured at their works. This machinery is of the latest type and includes automatic air-compressors, duplex-compressors, hoisting engines, rock-drills, engines and coal-mining machinery generally. This company was incorporated in 1870, and has the advantage of being situated in the midst of one of our great mining districts. As a result of this opportunity to study the actual works of the mining community, the various machines here illustrated seem to be unusually well adapted in design for the work intended.

CENTRAL FALLS, R. I., SEWERAGE.—Arthur R. Sweet, C. E., has completed plans for the drainage of the Blackstone river water-shed and an estimate of the cost of a system of sewerage for Central Falls. There will be required 19,875 feet of sewers, 23 flush-tanks, 707 man-holes, 87 lamp-holes, 78 catch-basins, and 19 gutter grates. The sewers will be of brick and pipe, from 8 to 36 inches in diameter; 63 per cent will be of 8, 10 and 12-inch Akron pipe; the estimated cost is an average of $17,594.67 per mile. In the system presented to the Lincoln Town Council by Engineer Sweet, and which was accepted by them, the estimated cost for flush tanks, man-holes, lamp-holes, catch-basins and gutter grates is $13,550; for the pipe, $26,288.10 and for the brick sewer, $10,803.70; the rock excavation, cutting through the bridge abutment and crossing the railroad, is estimated at $9,500, and the expenses for engineering and contingencies at $6,014.18, making a total of $66,155.98. At present it is only proposed to sewer a portion of the village, at an estimated cost of $10,077.

DUBUQUE BRIDGE.—The city of Dubuque, Ia., is constructing a large wagon bridge over the Mississippi river; it is a high level bridge with stone piers and iron superstructure. There is a channel span of 363 feet, four spans of 225 feet and two of 250 feet; the channel span is 80 feet above water. The contractor is H. E. Horton, Rochester, Minn., whose bid was $125,000; the masonry is being built by Bruce & Barron, Marseilles, Ill., subcontractors.